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SEP 10 1928

Electrical World

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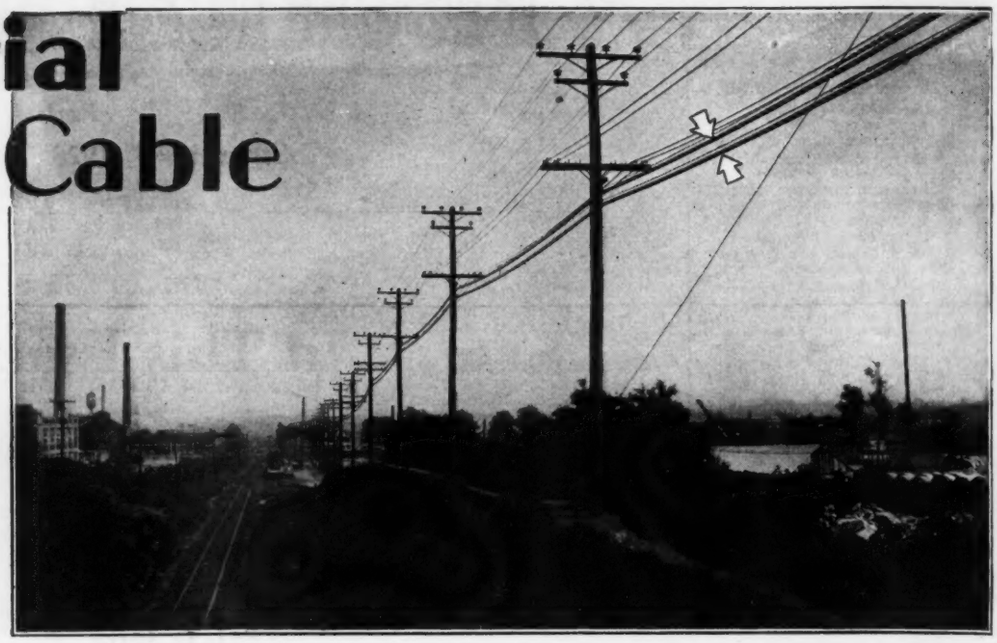
Aerial Power Cable



is often the RIGHT *answer* WHERE:

Tree conditions are unfavorable for other construction.

Right of way conditions make its use preferable.

Cost of underground cable construction is not justified.

Special protection to service is required.

Joint occupancy on pole lines is facilitated.

Limited pole space is a deciding factor.

Increased transmission capacity is needed on existing lines.

Added flexibility in making line repairs is needed.

Approaches to power stations, substations, and other terminals are congested.

Unfavorable soil conditions make underground construction impracticable.

Submarine cable can be avoided by aerial cable attached to bridges.

Trestles and highway bridges can best be crossed by aerial cable.

A quick cable installation is necessary.

A large power customer's load can best be handled by aerial cable.

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OKONITE

1878 OKONITE QUALITY STANDARDS 1928
Unchanged for Half a Century

Name of company	Brooklyn Edison Co.*†	Cleveland Elec. I
City	Brooklyn, N. Y.	Cleveland, O
Maximum area per station, sq.mi Minimum area per station, sq.mi Average area per station, sq.mi	12.55 2.06 5.44	13.3 1.3 5.75
Maximum load of substation Minimum load of substation Average load of substation	29,000 kva. 13,300 kva. 20,900 kva.	26,000 2,000 14,850
Ratio of installed capacity to peak load: Maximum Minimum Average		
Maximum station load per sq.mi Minimum station load per sq.mi Average station load per sq.mi	7,500 kva. 2,160 kva. 4,855	6,670 475 2,580
Total system load per sq.mi	3,850 kva.	Not determi
Maximum station load growth per year Minimum station load growth per year Average station load growth per year	30% 10% 19%	
System load growth per cent per year	19%	
Type of distribution system Type of primary feeders Phases of primary feeders Voltage of primary feeders	Underground and overhead Radial 3 2,400/4,150 (grounded neutral)	Underground and o Radial 3 Some 2,300, some 4,60 Lighting mostly 2,3 4,600 v.
Average capacity of distribution feeders, kva	1,500	Norm 2,300 v. lighting 40 2,300 v. power... 80 4,600 v. lighting. .. 4,600 v. power... ..
Average size of main feeder in circ.mil	250,000 Separate neutral in case of 3 conductor mains	Underground 105,500 Overhead 105,
Average size of branch feeders in circular mils	Underground 133,000/211,600 Overhead 133,000	26,300
Reserve capacity of distribution feeders	Rated, 1,500 kva. Loaded, 1,250 250 kva. reserve Allowable capacity of 50% Overload for one hour	An emergency powe emergency lighting provided from each with facilities for t mains of any regu There are also eme between the mains circuits
Means of spare feeder capacity in case of trouble	Feeders interconnected by emergency switches (normally open)	
Substation layout: Is high tension bus provided? Means of voltage regulation on feeders	No Automatic induction regulators on individual feeder or feeder groups	In attended statio In unattended stat Individual
Size of sub-station transformers, kva	10,000	1,000 kva. single p making 3,000 kva.
Type of sub-station transformers	3-phase	Single-phase u
No. of transformers or banks in average substation	4, including 1 spare	14—3,000 kva. ban
Amount of spare transformer capacity	10,000 kva.	3,000 kva. for each s
Means of obtaining most economical spare transformer capacity	Spare transformer fed by 27-kv. ring system and tied to 4,500 v. feeder group buses through synchronizing bus and reactors	
Means of utilizing spare transformer capacity		
Type of transmission system	Underground	Undergroun
Transmission voltage	27,000 volts	11,500
General layout of system, types of transmission, etc	Radial—tied in with ring	Cables run radially t
Capacity, type and size of transmission cable	350,000 circ.mil, 10,000 kva. cap., 3 cond. grounded neutral	3,000 kva., 211,500
Relation between cable kva. capacity and peak load; spare or reserve	Ring contains spare	At least one cable in e load requirement each substation
Remarks	*Correct to Dec. 30, 1927 †Applies only to 60 cycle portion of system	*Stations serving con and rural territor

Table II—Substatio

ec. Ill. Co.*	United Elec., Lt. & Pwr. Co.	New York Edison Co.	Detroit Edison Co.	Duquesne Light Co.	Commonwealth Edison
d, Ohio	New York, N. Y.	New York, N. Y.	Detroit, Mich.	Pittsburgh, Pa.	Chicago, Ill.
3 3 75	5.14 0.85 3.5	6.52* 1.93* 3.38* 13.51†	19.0 0.53 4.93		16.19 0.625 3.94
000 000 350	13,925 kw. 10,650 kw. 12,000 kw.	25,031 kva.* 20,679 kva.* 22,100 kva.* 7,571 kva.†	37,210 1,100 11,820		16,700 2,500 8,500
	2.12 1.75 1.88	1.16* 0.96* 1.09* 2.8	4.07 1.44 1.99	2.53 0.88 1.53	1.82 0.97 1.24
570 475 580	14,200 kw. 2,035 kw. 3,580 kw.	11,300 kva.* 3,840 kva.* 8,070 kva.* 560 kva.†	19,100 102 5,060		7,700 350 1,950
rmined	3,580 kw. (1926)	6,280 kva.		300 approximate	2,090
	32.0% 2.1% 13.3%		+59% (compared to Nov., 1926) —49.5% (compared to Nov., 1926) +¼% (compared to Nov., 1926)		
	13.3%	15	+10.4% (avg. last three years)		15
nd overhead ial 4,600, all delta. 2,300 v., power	Underground Radial and network 3 3,000 and 13,800, 3-wire grounded through grounding transformer bank	Underground and overhead Radial 2 2,300 Underground Radial 3 13,800‡	Underground and overhead Radial 1–3 2,400–4,800 three phase, 4,800 v. light and power	Underground and overhead Radial 3 4,000 4 wire, some old 3 wire, 2,300 v.	Underground with overh laterals Radial segregated pha 3 4,000 4 wire grounded neu
Normal Max. 400 540 800 1,000 ... 800 ... 1,600	1,038 kva. (3,000 v.) 200 amps. per leg 7,160 kva. (13,800) 300 amp. per leg	U. G. 13,800 v., 3,000 kva., 3 phase U.G. 2,300 v., 1,000 kva., sin. phase O.H. 2,300 v., 1,000 kva., sin. phase	Single phase, 500 3 phase lighting, 1,200 to 1,500 Power, 2,500	2,200 kva. dense load 1,400 kva. residential	850
,500 and 211,600 105,500	3 conductor 250,000- 3,000 v. 1 conductor 211,600- 3,000 v. 1 conductor 250,000-13,800 v.	2,300 v. underground, 2-200,000 in parallel; 2,300 v. overhead, 4 1/0 in parallel; 13,800 v. underground, 150,000	211,600	Underground 350,000/500,000 Overhead 211,600	105,500
300	211,600	2,300 v. underground, 200,000 2,300 v. overhead, No. 1/0 13,800 v. underground, 150,000	Backbone, 66,400 Branch, 26,300	Overhead 66,358/105,560	Tendency now to use 1 (Now 25%) 26,250 (Now 75%)
power and an ting feeder are each substation, for tying to the regular feeder. emergency ties ains of adjacent	4,000 kva.	No reserve capacity on radial system. New system will have reserve capacity	Spare feeders provided where possible. Jumper points arranged for primary feeders. Additional feeders strung when necessary	50% reserve in downtown districts; less in outlying districts	25%
	Feeders, interconnected, also feeders not fully loaded due to lighting load on one-phase only and also secondary supported by network		Feeders interconnected (emergency switches)	Feeders interconnected using emergency switches	Feeders interconnected th emergency switches
tations, yes stations, no dual	Yes Individual	Yes Individual on 2,300 v. feeders; group bus regulation 13,800 v. feeders	Yes (in switching stations only) Group and individual	Yes Individual single phase induction regulators	Yes Individual
le phase units, kva. banks	2,000	6,000 kva. per bank of two transformers in 2,300 v. sta.; none in use in 13,800 v. sta.	6,000 8,500 10,000	5,000 and 10,000 per bank	3,000-5,000 (unattende 5,000-7,500 (attended)
ase units	Single phase, delta to delta banks	Single-phase, Scott connected	3 phase	3 phase banks or equivalent single phase units	3-phase
. banks, max.	5	4-6,000 kva. banks (rated 7,000 kva. during winter months)	6		2 to 5 banks
ach sec. voltage	Sufficient capacity in service so that loss of one bank is permissible without overloading remaining banks	4,000 kva. (1,000 kva. per bank)	Capacity of largest unit	⅓ total rating	25%
	Sufficient capacity kept in service so that loss of any one bank will not overload remainder		Newer substation built with provision for ultimate capacity and transformer. Size standardized. Only few transformer sizes need be kept in stock. Overload banks until repairs are made	By margin of excess capacity and by overloading depending upon numbers of banks installed	Reserve units ready for in tion. Enough spare so load of sub-station ma transferred among othe stations without overl
	Banks not fully loaded	No additional switching equipment required; spare capacity within each bank	Spare unit	Banks not fully loaded	Banks not fully loade
ground	Underground	Underground	Underground	Overhead and ungerground (in city proper)	Underground
500	13,800 and 7,800	13,200	24,000	11,000 and 22,000 Also 66,000 volt ring	12,000
lly to substations	Radial feed with station ties	Each station is fed from 2 generating stations, buses divided into two sections, each fed from a different generating station	Radial feed to substations with loose ties between power plants	Radial for 11 and 22 kv. Ring for 66 kv.	Radial system loop feedi dependent. Customer smaller sub-station
1,500 circ.mil	350,000 circ.mil—3 cond. 250,000 circ.mil—1 cond.	350,000 circ.mil, 3 conductors 300,000 circ.mil, single conductor	3/0-3 cond. pwr. and ltg., 125A, 5,200 kva. 350 Mcirc.mil, 3 cond, pwr. and ltg., 225A-9,400 kva.	Underground 11,000 v., 500,000 circ.mil.; 22,000 v., 350,000 circ.mil. Overhead, 2N, 600/105,500 circ.mil.	Direct lines 500,000 cir Loop lines 250,000 cir
e in excess of full ent is run to n					
g combined city rritory excluded		*For 2,300 volt stations. †For 13,800 volt stations. ‡From 172nd St. sta. supplying Scott connected three-phase to two phase, 13,800/230-115 v. transformer bank			

UNIV. OF MICH.

Table II—Substation Practice of Representative Utilities in the United Sta

	Duquesne Light Co.	Commonwealth Edison Co.	Philadelphia Electric Co.*	Cons. Gas, Elec. Lt. & Pwr. Co.	Public Service Co. of Colorado
	Pittsburgh, Pa.	Chicago, Ill.	Philadelphia, Pa.	Baltimore, Md.	Denver, Col.
		16.19 0.625 3.94	9.86 0.66 3.81	9.55 2.55 6.08	18.3 6.5 9.8
		16,700 2,500 8,500	15,710 8,480 10,600	15,800 4,230 9,762	13,950 1,080 7,030
	2.53 0.88 1.53	1.82 0.97 1.24	3.75 1.25 1.98	3.34 1.405 2.50	1.79 0.83 1.22
		7,700 350 1,950	11,000 960 2,970	2,000 1,350 1,683	1,277 279 651
	300 approximate	2,090		1,605	558
6) 26) 6)				14.5% 7.0% 11.6%	
s)		15	10–15	10%	
v.	Underground and overhead Radial 3 4,000 4 wire, some old 3 wire, 2,300 v.	Underground with overhead laterals Radial segregated phase 3 4,000 4 wire grounded neutral	Underground and overhead Radial & loop (in downtown dist.) 2 2,400, 3-wire Tabulation shows 2,400, 4-wire	Underground and overhead Radial 3 4,000 4 wire	Overhead Radial 3 2,300/4,000 Star–4-wire
00	2,200 kva. dense load 1,400 kva. residential	850	960 radial 1,250 loop	600 to 1,000 kva.	550 kw. per phase max., 46 kva regulators, between phas neutral on lighting and smal power service; some 4,000 v
	Underground 350,000/500,000 Overhead 211,600	105,500	133,100	1/0 and 4/0	211,600 or 133,225
	Overhead 66,358/105,560	Tendency now to use 105,500 (Now 25%) 26,250 (Now 75%)	41,470	No. 6 and No. 4	26,245 or 41,615
re r- s. n	50% reserve in downtown districts; less in outlying districts	25%	25%	Extra capacity in one feeder in each four sufficient to carry load on any one of other three	No reserve maintained. As sys tem expands, mains are abutte to allow for disconnects be tween mains of two feeder (emergency)
	Feeders interconnected using emergency switches	Feeders interconnected through emergency switches	Feeders interconnected (Emergency switches)	By oil switch ties from parent feeder to other three	
r)	Yes Individual single phase induction regulators	Yes Individual	Yes Individual on radial circuits with bus regulation at loop circuit substations	Yes, in most sub-stations No, in 2 sub-stations Individual	Yes Individual
	5,000 and 10,000 per bank	3,000-5,000 (unattended) 5,000-7,500 (attended)	3,750 kva. 7,500 kva. per bank	6,000 and 10,000	3-1,667 kva. (5,000 kva. banks)
	3 phase banks or equivalent single phase units	3-phase	Single-phase	3-phase auto	Single phase
		2 to 5 banks	4-7,500 kva. banks (Some cases 6 banks)	3 or 4 6,000 kva. or 2 to 3 10,000 kva.	2 banks
	⅓ total rating	25%	1–7,500 kva. bank	1–6,000 kva.	1 spare at each substation
o- y i- er k. rs	By margin of excess capacity and by overloading depending upon numbers of banks installed	Reserve units ready for installation. Enough spare so that load of sub-station may be transferred among other sub-stations without overloading	Supply 1 spare, single-phase unit for economy. Spare bank most reliable and is used; fits in with system	1 unit spare in each substation where no frequency changers installed	Small single phase transforme with spare is economical; ⅓ or of station transformer capacity is idle
	Banks not fully loaded	Banks not fully loaded	Spare bank in readiness	Spare connected at all times	Spare in readiness
	Overhead and ungerground (in city proper)	Underground	Overhead and underground (In congested districts)	Underground	Overhead
	11,000 and 22,000 Also 66,000 volt ring	12,000	13,200	13,200 in city	13,000
th ts	Radial for 11 and 22 kv. Ring for 66 kv.	Radial system loop feeding independent. Customers and smaller sub-station	Radial system	Radial	Overhead delta; proposed 22 kv Y-connected; neutral grounded Radial
A, d	Underground 11,000 v., 500,000 circ.mil.; 22,000 v., 350,000 circ.mil. Overhead, 2N, 600/105,500 circ.mil.	Direct lines 500,000 circ.mil Loop lines 250,000 circ.mil	Underground 350,000 circ. mil., 3 cond. rated 6,000 kva., overhead 133,000 circ. mil., rated 5,000 kva	350,000 circ.mil.	300,000 circ.mil copper; 211,00 cir.mil. copper; 500,000 circ. mil. Al. covered steel reinf
				1 cable spare to each sub-station	Single O. H. capacity not definitely
			*Data based on 1926 conditions for urban stations only		

tates

rado	Puget Sound Lt. & Pwr. Co.	Milwaukee Elec. Ry. & Lt. Co.	Rochester Gas & Elec. Corp.	Public Service E. & G. Co.	N. Y. & Queens Elec. Lt. & Pwr. Co.
	Seattle, Wash.	Milwaukee, Wis.	Rochester, N. Y.	Newark, N. J.	New York, N. Y.
	9.46 0.30 3.56	9.20 3.77 6.77	53.45 0.1 20.65 (12 stations)	9.42 1.10 4.09	36.0 4.6 17.0
	12,050 650 4,244	25,000 4,000 9,000		26,000 2,700 9,350	35,300 7,500 14,842
	2.22 1.16 1.37	1.86 (small sta.) 1.09 1.35		2.59 1.16 1.69	2.0 1.2 1.5
	25,100 peak 202 peak 1,190 peak	3,950 500 1,440		7,850 733 2,340	4,750 375 1,520
	1,190	180 (Includes rural territory)		277	860
	No data No data 8%	75% 6% 13.8%		10.3%	22% 7.5% 17%
		8%	16.3%	11.0%	14%
	Underground and overhead Radial 3 4,500 4,500-3-phase, grounded neutral; 2,400-1-phase, lighting; 4,500-3-phase underground ltg. & pwr.	Underground and overhead Radial 3 2,200/3,810 Radial—Ground neutral	Radial 4 conductor lead cables 3 4,150/2,400 4-wire	Underground and overhead Radial 3 4,150 4-wire	Overhead and underground Overhead and underground 3 2,300/4,000
kva. phase small 00 v.	200-300 amps., depending on length; capacity of underground dist. cable 300 amps.	200 amp. or 1,320 kva.	1,200 kva.	2,000 kva.	400 amp. per phase or 2,770 kva., 3 phase
	Overhead, 211,600 Underground, 350,000 (3 cond.)	Underground 250,000 Overhead 211,000 or 105,625	167,000	Underground 133,225 or 350,000 circ.mil Overhead 133,225 or 211,600 circ.mil	250,000 mostly Also 350,000
	Overhead (network), 41,615 Underground, 66,565	Overhead 105,625 to 26,245 Underground 250,000 or 100,000	66,565	26,245 to 83,600 circ.mil Mostly 83,600 circ.mil	133,225-66,565
sys- utted s be- eders	25%	30%	Reliability reserve is automatically provided by construction which anticipates future growth	All feeders not fully loaded	One station, two spare feeder equipments. Three stations, one spare feeder equipment. Others, group feeder regulator, no spare feeder equipment. Some reserve in all cables and lines, tie-ins
		Feeders interconnected by emergency switches; also 1 spare	Tieing	Additional load cut over to partly loaded feeders	Sectionalizing and portions of feeders tied together in emergency
	Yes Individual	Yes Single phase reg. on each phase or feeder	Yes Auto voltage regulators	Yes Individual	In five sub-stations—Yes In remaining two—No Group and individual
	3,000 kva. expanding to 5,000 kva	2,000-15,000 kva. depending on load	5,000 kva.	Standard unit, 4,000 kva., three phase	3,750-5,000-7,500-15,000 kva.-2 winding 12,000-15,000 kva., 3 winding
	3-phase	3 phase	3 phase	Standard unit, 3-phase. Older unit, single phase	3 phase
	5 banks and 1 spare	Maximum 6	2 or 3	2 or 3 banks	2 to 5
on	1 standard size bank per sta.	1 spare unit per station	50–100%	Major sub. 1 spare bank Minor sub. 1 spare unit	Equal of largest 3-phase unit
ormer ½ or ¼ pacity	3,000 kva. units or less used on small loads, idle transformer capacity kept at minimum consistent with good operating practice	Sufficient capacity to carry load with one transformer out of service without serious overload. Initial installation, 2-3,000 kva., then 3-3,000, 2-5,000, etc.	Former practice 3-phase transformers. Up to 60,000 v. Considering single phase transformer with 110,000 v. 4-single phase transformer cheaper, but 2-3-phase transformers are more flexible	1 spare, 4,000 kva., 3 phase unit in smaller stations, single phase transformer not connected. Spare installed when station is built	Enough spare so that peak load can be carried with the largest unit out of service, not overloading the rest; 3-phase units most economical
		Banks not fully loaded. Spare in readiness	Banks not fully loaded	Major subs, spare fully switched. Minor subs, spare idle, ready to be connected	Banks not fully loaded
	Chiefly overhead	Mostly underground	Underground	Underground and overhead	Overhead and underground
	55,000 and 13,800	13,800 within 7 mi. from gen. 27,600 greater than 7 mi.	11,000	13,200 v. and 26,400 v.	Mostly 13,200; some 26,400 Most future extensions, 26,400
22 kv. unded.	Radial system with duplicate parallel lines, underground in central business district, overhead elsewhere	Mostly ungerground radial, neutral grounded; 13,800 v. through 3 ohms, 27,600 v. solid	Underground radial neutral, grounded through 30 ohms	Radial from generating or high voltage switching station	Substations fed radially from the generating station with inter-station tie feeders
11,000 circ.- reinf.	Mainly 105,625 133,225 and 2 N, 600 circ.mil. (std.)	13,800 v., 3 cond., 500,000 circ.mil. 8,000 kva., 211,000 circ.mil. 4,000 kva., 27,600 v., 3 cond., 350,000 circ.mil., 10,000 kva.	133,225 circ.mil, 146 amp.; 250,000 circ.mil, 216 amp.; 350,000 circ.mil, 270 amp.	All underground cable, 350,000 circ.mil; all overhead transmission 250,000 circ.mil, and insulated for 26,400	350,000 circ.mil 500,000 circ.mil
ot	About 30% reserve	Transmission cables loaded 110% capacity during winter peak	Varies maximum load about 80% of cable capacity	Spare transmission circuit to each sub. or to each group of subs., where two are tied together	From 10% to 25% reserve

UNIV. OF MICH.

esentative Utilities in the United States

*	Cons. Gas, Elec. Lt. & Pwr. Co.	Public Service Co. of Colorado	Puget Sound Lt. & Pwr. Co.	Milwaukee Elec. Ry. & Lt. Co.	Rochester Gas & Elec. Co
	Baltimore, Md.	Denver, Col.	Seattle, Wash.	Milwaukee, Wis.	Rochester, N. Y.
	9.55 2.55 6.08	18.3 6.5 9.8	9.46 0.30 3.56	9.20 3.77 6.77	53.45 0.1 20.65 (12 stations)
	15,800 4,230 9,762	13,950 1,080 7,030	12,050 650 4,244	25,000 4,000 9,000	
	3.34 1.405 2.50	1.79 0.83 1.22	2.22 1.16 1.37	1.86 (small sta.) 1.09 1.35	
	2,000 1,350 1,683	1,277 279 651	25,100 peak 202 peak 1,190 peak	3,950 500 1,440	
	1,605	558	1,190	180 (Includes rural territory)	
	14.5% 7.0% 11.6%		No data No data 8%	75% 6% 13.8%	
	10%			8%	16.3%
d dist.) wire	Underground and overhead Radial 3 4,000 4 wire	Overhead Radial 3 2,300/4,000 Star–4-wire	Underground and overhead Radial 3 4,500 4,500-3-phase, grounded neutral; 2,400-1-phase, lighting; 4,500-3-phase underground ltg. & pwr.	Underground and overhead Radial 3 2,200/3,810 Radial—Ground neutral	Radial 4 conductor lead cables 3 4,150/2,400 4-wire
	600 to 1,000 kva.	550 kw. per phase max., 46 kva. regulators, between phase neutral on lighting and small power service; some 4,000 v.	200-300 amps., depending on length; capacity of underground dist. cable 300 amps.	200 amp. or 1,320 kva.	1,200 kva.
	1/0 and 4/0	211,600 or 133,225	Overhead, 21,600 Underground, 350,00 (3 cond.)	Underground 250,000 Overhead 211,000 or 105,625	167,000
	No. 6 and No. 4	26,245 or 41,615	Overhead (network), 41,615 Underground, 66,565	Overhead 105,625 to 26,245 Underground 250,000 or 100,000	66,565
	Extra capacity in one feeder in each four sufficient to carry load on any one of other three	No reserve maintained. As system expands, mains are abutted to allow for disconnects between mains of two feeders (emergency)	25%	30%	Reliability reserve is automa cally provided by constructi which anticipates futu growth
	By oil switch ties from parent feeder to other three			Feeders interconnected by emergency switches; also 1 spare	Tieing
with rcuit	Yes, in most sub-stations No, in 2 sub-stations Individual	Yes Individual	Yes Individual	Yes Single phase reg. on each phase or feeder	Yes Auto voltage regulators
	6,000 and 10,000	3-1,667 kva. (5,000 kva. banks)	3,000 kva. expanding to 5,000 kva	2,000-15,000 kva. depending on load	5,000 kva.
	3-phase auto	Single phase	3-phase	3 phase	3 phase
	3 or 4 6,000 kva. or 2 to 3 10,000 kva.	2 banks	5 banks and 1 spare	Maximum 6	2 or 3
	1–6,000 kva.	1 spare at each substation	1 standard size bank per sta.	1 spare unit per station	50–100%
e unit bank d; fits	1 unit spare in each substation where no frequency changers installed	Small single phase transformer with spare is economical; ½ or ⅓ of station transformer capacity is idle	3,000 kva. units or less used on small loads, idle transformer capacity kept at minimum consistent with good operating practice	Sufficient capacity to carry load with one transformer out of service without serious overload. Initial installation, 2-3,000 kva., then 3-3,000, 2-5,000, etc.	Former practice 3-phase tra formers. Up to 60,000 v. Co sidering single phase tra former with 110,000 v. 4-sin phase transformer cheaper, b 2-3-phase transformers more flexible
ss	Spare connected at all times	Spare in readiness		Banks not fully loaded. Spare in readiness	Banks not fully loaded
und s)	Underground	Overhead	Chiefly overhead	Mostly underground	Underground
	13,200 in city	13,000	55,000 and 13,800	13,800 within 7 mi. from gen. 27,600 greater than 7 mi.	11,000
	Radial	Overhead delta; proposed 22 kv. Y-connected; neutral grounded. Radial	Radial system with duplicate parallel lines, underground in central business district, overhead elsewhere	Mostly ungerground radial, neutral grounded; 13,800 v. through 3 ohms, 27,600 v. solid	Underground radial neutral grounded through 30 ohms
mil., erhead 00 kva	350,000 circ.mil.	300,000 circ.mil copper; 211,000 cir.mil. copper; 500,000 circ.-mil. Al. covered steel reinf.	Mainly 105,625 133,225 and 2 N, 600 circ.mil. (std.)	13,800 v., 3 cond., 500,000 circ.mil. 8,000 kva., 211,000 circ.mil. 4,000 kva., 27,600 v., 3 cond., 350,000 circ.mil., 10,000 kva.	133,225 circ.mil, 146 amp.; 250,000 circ.mil, 216 amp.; 350,000 circ.mil, 270 amp.
	1 cable spare to each sub-station	Single O. H. capacity not definitely	About 30% reserve	Transmission cables loaded 110% capacity during winter peak	Varies maximum load about 8 of cable capacity
ndition y					

Corp.	Public Service E. & G. Co.	N. Y. & Queens Elec. Lt. & Pwr. Co.	Kansas City Pwr. & Lt. Co.*	So. California Edison Co.
	Newark, N. J.	New York, N. Y.	Kansas City, Mo.	Long Beach, Cal.
ions)	9.42 1.10 4.09	36.0 4.6 17.0	24.3 1.38 8.71	4.0 0.4 2.0
	26,000 2,700 9,350	35,300 7,500 14,842	15,500 750 7,725	5,300 330 2,971
	2.59 1.16 1.69	2.0 1.2 1.5	2.41 1.25 1.8	2.40 2.00 2.19
	7,850 733 2,340	4,750 375 1,520	4,510 384 1,617	10,500 720 1,340
	277	860	883	220
	10.3%	22% 7.5% 17%	45% 8.6% 24.3%	20%
	11.0%	14%	12%	20%
les	Underground and overhead Radial 3 4,150 4-wire	Overhead and underground Overhead and underground 3 2,300/4,000	Underground and overhead Radial 3 2,300/4,000 4 wire, neutral grounded at station	Underground and overhead 3 4,000 Grounded
	2,000 kva.	400 amp. per phase or 2,770 kva., 3 phase	1,000-1,500 kva. (150-200 amp.)	800 kva. at 2,300 v.; 1,400 kva. at 4,000 v.
	Underground 133,225 or 350,000 circ.mil Overhead 133,225 or 211,600 circ.mil	250,000 mostly Also 350,000	Overhead, 105,625 Underground, 168,100-4 cond.	Overhead 133,225 Underground 300,000, 3 cond.
	26,245 to 83,600 circ.mil Mostly 83,600 circ.mil	133,225-66,565	Overhead 26,245 Underground same as main	Overhead 41,615 Underground, same as main
tomati- ruction future	All feeders not fully loaded	One station, two spare feeder equipments. Three stations, one spare feeder equipment. Others, group feeder regulator, no spare feeder equipment. Some reserve in all cables and lines, tie-ins	Up to 25%	30%
	Additional load cut over to partly loaded feeders	Sectionalizing and portions of feeders tied together in emergency	All feeders tied to adjacent circuits	Portions of feeders tied together in emergency
ors	Yes Individual	In five sub-stations—Yes In remaining two—No Group and individu al	No Individual	Yes Individual
	Standard unit, 4,000 kva., three phase	3,750-5,000-7,500-15,000 kva.-2 winding 12,000-15,000 kva., 3 winding	3,000, 6,000, 7,500 kva.	1,000 kva. and 2,000 kva.; 3,000 kva. per bank and 6,000 kva. per bank.
	Standard unit, 3-phase. Older unit, single phase	3 phase	3 phase, single phase rural	Single phase
	2 or 3 banks	2 to 5	2 or 3	1 to 2
	Major sub. 1 spare bank Minor sub. 1 spare unit	Equal of largest 3-phase unit	25–50%	One unit
e trans- v. Con- trans- 4-single per, but rs are	1 spare, 4,000 kva., 3 phase unit in smaller stations, single phase transformer not connected. Spare installed when station is built	Enough spare so that peak load can be carried with the largest unit out of service, not overloading the rest; 3-phase units most economical	System radial, so stations operate continually. Spare picks up load in emergency with only momentary interruption	In important locations, 2 banks of 3 single-phase transformers are installed for peak loads; at others, 1 bank and a spare
ded	Major subs, spare fully switched. Minor subs, spare idle, ready to be connected	Banks not fully loaded	Spare connected at all times	Banks not fully loaded
	Underground and overhead	Overhead and underground	13,200 v. underground 33,000 v. overhead	Mainly overhead
	13,200 v. and 26,400 v.	Mostly 13,200; some 26,400 Most future extensions, 26,400	13,200 Kansas City 33,000 rural	11,000
eutral, ohms	Radial from generating or high voltage switching station	Substations fed radially from the generating station with inter-station tie feeders	13,200 v. is mainly underground radial; 33,000 v. is overhead radial	Mainly overhead
amp.; amp.; amp.	All underground cable, 350,000 circ.mil; all overhead transmission 250,000 circ.mil, and insulated for 26,400	350,000 circ.mil 500,000 circ.mil	13,000 v., 400,000 circ.mil, 6,000 kva.; 33,000 v. is al. covered steel reinf.	Overhead 211,600 circ.mil or 133,225 circ.mil, copper; underground 350,000 circ.mil paper and lead
out 80% y	Spare transmission circuit to each sub. or to each group of subs., where two are tied together	From 10% to 25% reserve	Up to 100% will be reduced as load develops	33% reserve

*Correct to Nov. 1, 1927

Electrical World

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W. H. ONKEN, JR.
Editor

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Adjustment Better than Litigation

NEWS from Los Angeles that five suits involving the Southern California Edison Company and the city's Bureau of Power and Light are to be dropped because three controversies of long standing between the company and the city have been settled out of court will win the applause of all save the incurably litigious, if any such there be. As a result the city will abandon its plans for a steam-electric generating plant at a harbor site and will accept instead the exclusive right to the output from one of the company's 35,000-kw. units at Long Beach; the company will proceed to install new equipment at that station, and the disputes over taxation and charges for power will be compromised. Whether this amicable arrangement was helped by the company's prompt and ample response to the city's cry for help last March when the St. Francis Dam went down we do not know. To a public-spirited citizen who acted as voluntary mediator the credit is given. The company and the city deserve hearty congratulations and the citizen a statue if no reward of a more convertible character tempts him.

* * * *

Quantity and Quality in Electrical Conventions

TWENTY-THREE conventions of national, sectional or single-state scope were listed in the ELECTRICAL WORLD of last week as to take place in September or October. They include meetings of six divisions of the National Electric Light Association, one of the Institute, one of electrical manufacturers, two of state utility associations, two of lighting engineers, two of electrical inspectors, and one each of the Society for Electrical Development, the electrochemists, the electric railway men, the mechanical engineers (who always have a power session), the Edison illuminating company executives, the Safety Council (Public Utilities Section), the Southern Appalachian Power Conference, the electric welders and the municipal electricians. In only one case are the sessions closed to all but members, and in all save three or four cases matter of more than local or specialized interest to electrical engineers, executives or commercial heads is pretty sure to come up for discussion.

Eleven of the conventions are to be in the East, five in the Middle West, four in the South, two in Colorado and one in Canada. The Pacific Coast held three in the summertime—comparatively quiet elsewhere. In the spring conventions will be bunched again, extending right up to the big gathering of the N.E.L.A. at Atlantic City, and there is seldom a week in the fifty-two when some meeting of enough general importance to call for mention in our columns does not occur.

Here is another significant evidence of the great growth of the electrical industry; for though there may be a few among the meetings which could be dropped without detriment, complaint of a plethora is not common. Whatever criticism they arouse is almost sure to be directed not to quantity but to quality. It is with electrical conventions as with other things: There can hardly be too many of outstanding character. Their nation-wide constituency can support them. They will be forgotten the next week or remembered for years according to what they bring forth.

* * * *

Income Taxes and Export Trade

IN THE flurry of emotional appeals incidental to a presidential campaign many fundamental conditions in national economic developments are likely to be passed over. Typical of these at the present time are the merits of relying very largely upon income taxes for the conduct of the federal government and the possibilities for export trade commensurate with recent investment of American dollars in foreign enterprises.

It takes nearly three billion dollars a year to run the government, and about $2,200,000,000 of this in 1928 came from income taxation as compared with only $615,000,000 received from all other internal revenue sources. Previous to 1914 the idea of direct taxation was abhorrent to American experts on taxation, yet today the income tax is relied upon for a very large proportion of the national income. This practice may be necessary and may be best, but a post-wartime discussion of the present ideas in taxation and of the proper proportion of the money to be raised by the direct taxation of the producers of the country would seem worth the time of statesmen.

A second suggested topic of discussion is the possibility of expanding foreign trade. Much American money has gone afield in recent years, and business might well follow it there. Many economists, moreover, hold that permanent prosperity for the farmer and for the manufacturer can come only when export trade is built up to absorb surplus productive capacity. Other students of economics disagree with these opinions.

It would be informative and interesting to have a national discussion of this topic, and in the discussion the government's relation to foreign trade development might well be introduced. In past times the sword prepared the way for the traders who make nations wealthy. This method of developing foreign business failed, but

it may be that a method by which the business man would follow a trail paved with the American dollar would be successful.

A presidential campaign can be used for national educational purposes, and basic ideas such as have been suggested might well be presented and discussed. Such a program well deserves part of the campaign fund of $10,000,000 reported as contemplated for expenditure by the political parties.

* * * *

Will Rate Cases Become Obsolete?

IT IS probably too early in the history of inducement type rates to reach the optimistic conclusion that their use is bound within a few years largely to do away with appeals to commissions by customers seeking lower prices for electric service. Nevertheless, it ought to be apparent before long that such rates are becoming a positive factor in stabilizing customer-company relations throughout the country; not by any means the only such factor, of course, but one potent for good in the direction of reducing the likelihood of disputes over charges for electricity. Wherever it is possible for a customer to increase his use of service substantially at a price per kilowatt-hour low in comparison with the initial rate or with rates associated with the earlier days of the industry, the conditions are favorable for the development of increased business on a basis which the customer readily appreciates if he thinks intelligently about the matter. If he does not view his bills analytically—and innumerable persons merely glance at the total cost of their service for the period covered and compare it in the rough with their usual outlay for this purpose—he accepts the added service volume at a lower unit price more or less as a matter of course.

Very little political capital can be made out of a well-designed inducement rate, and latent causes of friction between the customer and the utility are reduced to such low terms that it is fair to expect a lessening in the number of rate cases brought before commissions from this time forward.

Students of commission regulation have long been aware of the comparative freedom of many power companies from industrial service rate cases. Some of this comparative immunity has no doubt been due to the care with which contracts have been prepared in connection with the conditions prevailing in specific industrial and mercantile establishments. Even where standard schedules of rates are applied to virtually all classes of business very little trouble seems to arise between power customers and the company. Without detailing the reasons for this, it may be said that low unit prices have a good deal to do with these excellent relations. Inducement type rates bring a power rate into the home, generally speaking, and this means that the old idea that prices are high must give way to some sort of realization that under present conditions electricity can be used freely, indeed lavishly, without burdensome expense.

As satisfaction with the service and its cost grows, whether consciously or not, the incentive to assail the company's rates tends to approach zero. It will be interesting to see if rate cases will not exhibit a palpable drop during the next five years in states where the inducement form of rate makes real progress toward general application and acceptance.

Pure Science Enriches Engineering Thought

AMERICA is noted the world over as the land of "short cuts." Quick results are in constant demand in this country, and a large proportion of its immense resources in men and material is devoted to their attainment. The electrical industry is one of the most powerful tools existing for speedy realization of the major concrete objectives of civilization. This is well, but it is not enough to study the progress of applied science in carrying forward the purposes of the engineering profession. Deeper foundations for the towering structure of our technical thinking are required as the edifice rises and broadens. As never before, the engineer is challenged to develop himself systematically by liberal reading and reflection upon many matters considerably removed from the daily problems of his work. It makes no difference whether he be a graduate of 1928 or of 1878.

Priceless opportunities are available for self-cultivation in pure science or economics. Taste will dictate choices, but the influence of the research laboratory upon electrical development is literally tremendous and cannot safely be overlooked by the engineer seeking depth of understanding of the vital trends of his profession. The literature of the electron, of radioactivity, of cosmic physics and chemistry contains amazing revelations. For the engineer to gaze upon these triumphs is to enrich his comprehension of those laws of nature which are fundamental to the universal order. Few can expect to acquire specialized standing in these domains of rarefied thought, but who can measure the benefit of a receptive interest in the achievements of research upon brain power, judgment and mental perspective?

* * * *

Consistent Industrial Lighting Rates Aid Customer Relations

SO MUCH executive attention has been focused of late upon residential service rates that the bearing of industrial lighting prices upon customer relations is at times in danger of being overlooked. In dealing with manufacturing customers it is advantageous to be able to present consistent rate structures capable of being logically applied and readily explained. The larger the demand and usage of energy, the more important it becomes to charge for service on a basis which reflects a broad viewpoint and which escapes the indictment of hairsplitting with respect to allocations of costs and tariff components.

In a recent instance a large manufacturer decided to install 250-volt direct-current lighting service supplied from a pair of synchronous motor-generator sets also required for variable-speed motor applications, in order to reduce the cost of lighting. The power company's rate schedules apparently penalized the use of alternating current for lighting service in the factory in comparison with the price of converting to direct current through the motor-generator sets. The manufacturer desired to install a 125-volt alternating-current lighting system, but he fell back on 250 volts "d.c." because the large number of variable-speed motors involved in his processes dictated the use of motor-generator sets, the lighting load being but 10 per cent of the direct-current power requirements and but 1 per cent of the total substation kva.

serving the establishment. The customer reported that the power company interposed no objection whatever to his transformation of alternating-current energy into direct-current lighting service at the regular power rate, but that it was impossible to do business on a satisfactory rate basis if he installed an "a.c." lighting system. The difference in monthly bills for lighting alone amounted to several hundred dollars, it was stated, on account of extensive long-hour usage of illumination throughout important portions of the industrial establishment.

Here we have a schedule of rates which the customer objected to on the ground of inconsistency and which he maintains required him to install a rating of wiring and lamps differing from his preference. He claims that the power company would make money and assure satisfaction to customers if it would bill both lighting and power service *en bloc,* and he points to practice elsewhere under which energy used in industrial lighting is billed at the power rate up to 10 per cent of the total consumption. It is unnecessary to follow through the details of this case to ascertain whether these contentions are fully justified in the particular instance, but the illustration points the lesson of giving more time and study to the consistency of industrial lighting rates and to the effect of varying ratios of demand and energy consumption for lighting and total power service upon the costs of supplying such business in specific industries and plants. It seems reasonable to conclude that where the ratio of lighting service to total usage is small a flexible policy in regard to rates will build more friendly relations than inflexible or inconsistent tariffs.

* * * *

The New Era in Lighting

THE uncomfortable, sly suspicion that even the best of efforts is desperately inadequate rests in the heart of every man who labors with a vision of anything better than a complacent present. In spite of many improvements and unquestioned results in securing finer illumination values and more efficient and attractive fixtures, as developed through years of earnest research, the illuminating engineer can hardly view today's best lighting practices with any approach to satisfaction. It is a long journey back to the crude oil lamp of our fathers, a slightly shorter interval to the old drop cord with its bare lamp, a far-from-ultimate halt for today's best.

A recent tendency in lighting practice has led to the adoption of sources of large area and low intensity. This has accompanied the exceedingly modern trend in architecture, furniture and decorations which has become increasingly noticeable in the past few months. Light has with these designers become a matter of architecture and decoration rather than an end in itself. Interesting developments have followed one another in home, shop, assembly hall, restaurant and window applications.

Is the natural light through an open window the ultimate thing to be approximated, or is this arbitrary cutting away of walls a valueless standard? Would a whole ceiling or wall constituting a light source prove worth while? Are columns or figures legitimate light sources? Shall it be incandescent-lamp or luminous-gas equipment? The problem will not be completely solved in the laboratory, by research or by economics; but, like everything else that concerns us as individuals, the vital business of rendering life more interesting and devising means to that end will influence future practices and may play havoc with existing ones.

Sell Complete Wiring When Buildings Are Planned

CHANGES are taking place in the American family's habits of living that have a particular bearing on the electrical industry. In the larger cities more and more people, whether they like it or not, are living in apartment houses. Others who have been forced to give up their detached homes because of city congestion and who dislike apartment-house life are moving to suburban towns and semi-rural districts. Whether the choice of the new domicile be an apartment or a home in the suburbs, the versatility of electric service can vastly improve living conditions. It is during this period of change that the industry should be especially alert to see that these new abodes are properly equipped electrically.

The best time to sell a complete wiring installation is when a building is being planned—not after its construction is well under way or nearly finished. Likewise this is the best time to sell the full complement of electrical equipment—range, refrigerator, water heater, washing and ironing machines—since the purchase of these devices can be included in the original financing.

There are many new apartment buildings going up in the larger cities and many new homes are being built in the smaller cities and suburban towns. People are moving into new homes. They want the modern conveniences, but too often the new structures are not adequately equipped electrically. It is up to the electrical industry—the central station, the manufacturer, jobber, contractor and dealer—to see that these new homes are properly wired and supplied with appliances when they are under construction, before the owner or builder has spent all his money for something else.

Unless this is done the industry in selling to the home can expect to continue the uphill sales battle that is so admirably and lamentably exemplified in the efforts to bring the wiring of already-built houses up to present-day standards.

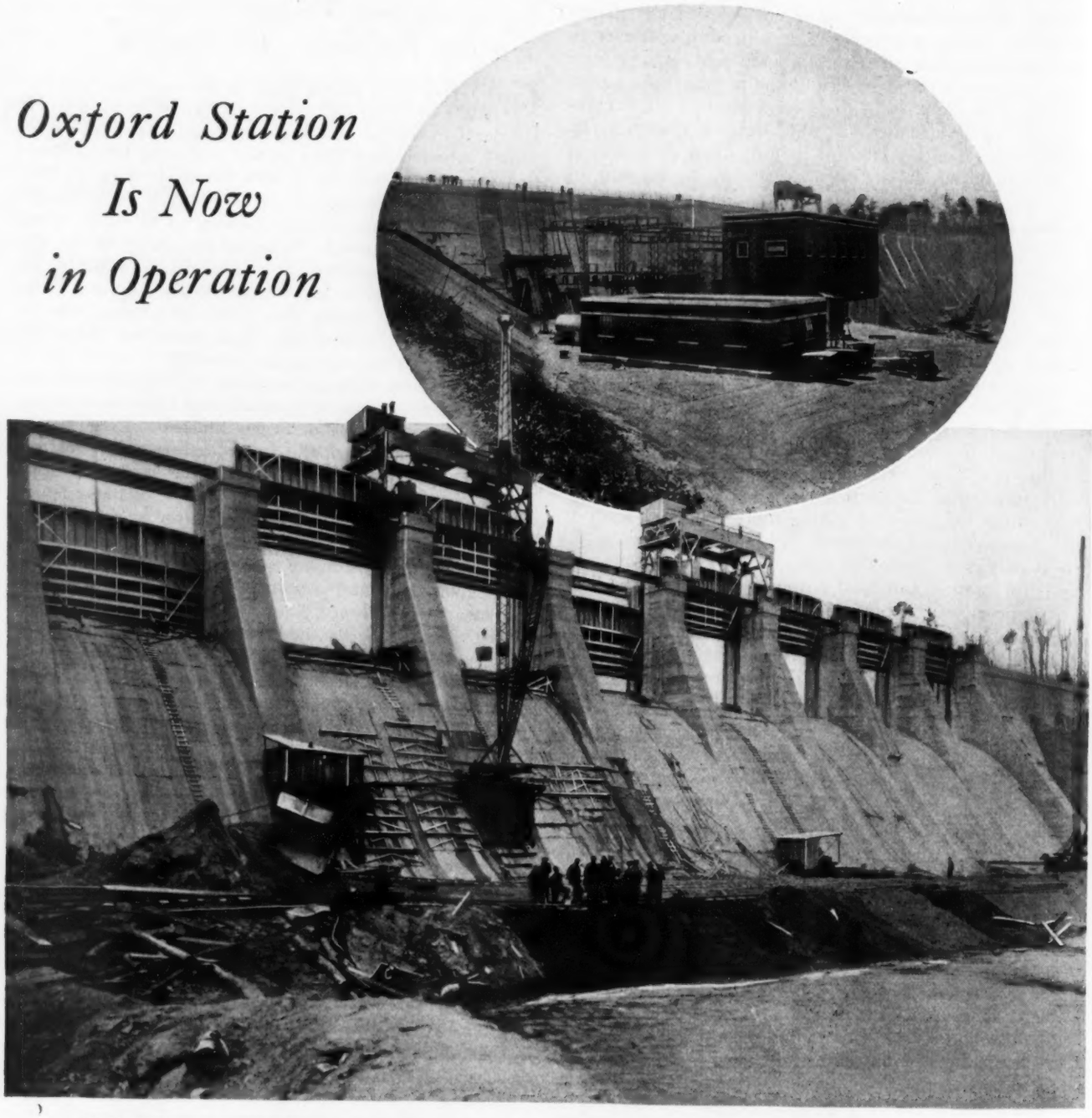
* * * *

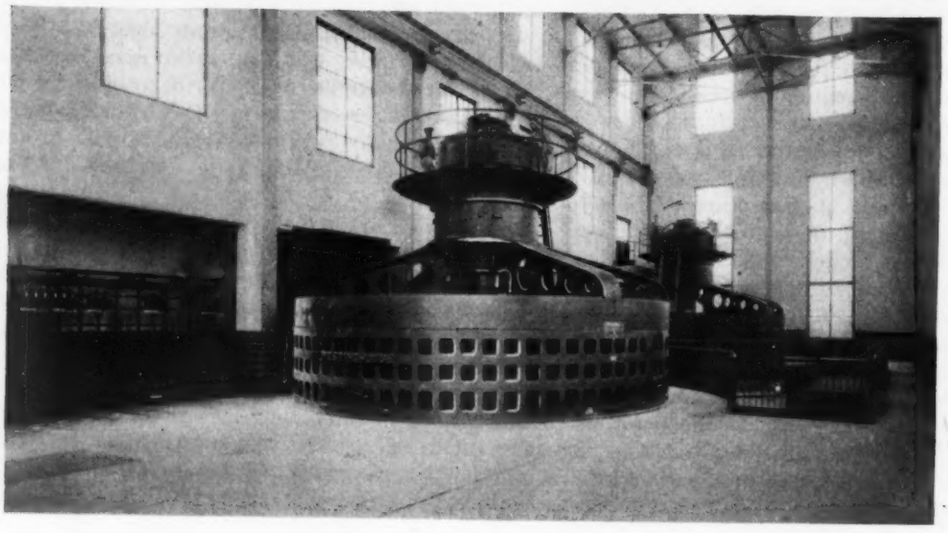
Making Interconnection Statistics Count

THOROUGH preparation, faithful continuance and intelligent analysis of interconnection statistics are essential to the sound development of this branch of operating practice among power companies. Liberal appropriations for intercompany metering from the first hour of interchange of energy are most important. Comprehensively designed log sheets and loose-leaf data forms are supremely necessary to an efficient conduct of affairs over intercompany ties. Adequate communication between system operators is vital to the prompt transmission of statistical data used by them in determining procedure.

If tie-ins grow more complex with the growth of systems, the engineer can attack the associated problems without the temptation to act on the basis of temporary observations or inadequate data, provided intercompany or interdivision activities are developed and maintained on the basis of adequate statistical co-ordination. The sharpest kind of definition is essential in connection with terms used in interchange relations. It is hardly going too far to declare that the statistical set-up of a modern interconnection is even more important than the intercompany contract.

Oxford Station Is Now in Operation





At top—Oxford station is one of twelve Duke Power Company plants utilizing the fall of the Catawba River in the Carolinas.

Center view—Spillway and sluicegates nearing completion.

At bottom—Two 22,500-kva. generators supply the planned capacity of this station.

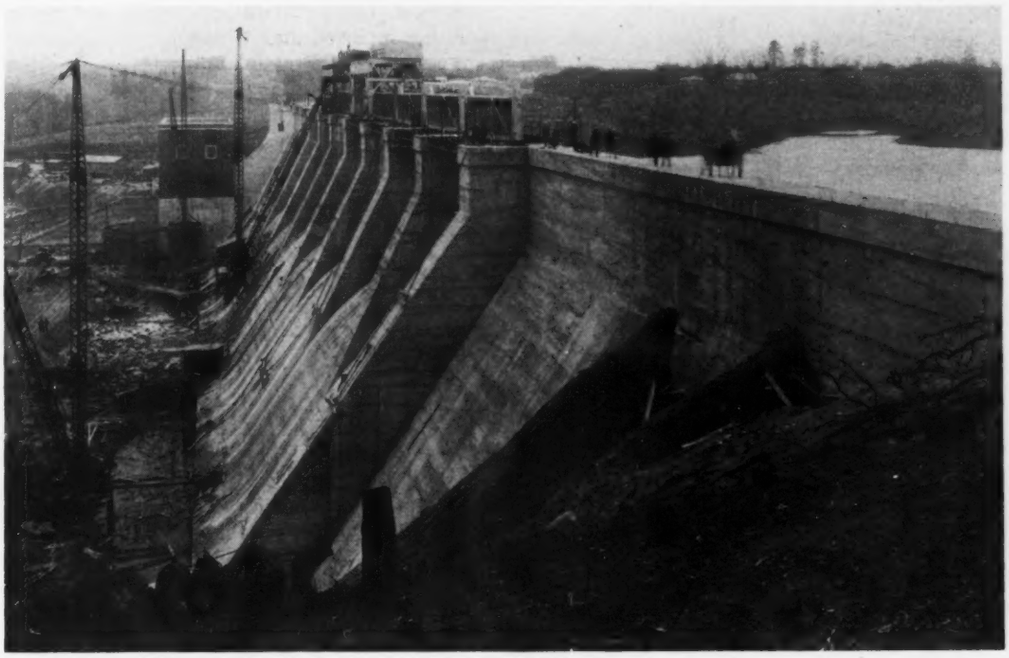
Another Step in

Catawba River Development

Oxford station of Duke Power Company constitutes twelfth link in comprehensive plan for utilization of North Carolina stream. Features of plant

By RICHARD PFAEHLER

Hydraulic Engineer with W. S. Lee, Consulting Engineer, Charlotte, N. C.



Oxford dam and station before water rose to operating head

TO KEEP up with the increase in demand for power in the Piedmont section of the Carolinas the Duke Power Company, serving a territory of about 350 miles in length and 150 miles in width in the western part of North and South Carolina, recently put into operation Oxford station, its twelfth hydro-electric station on the Catawba River.

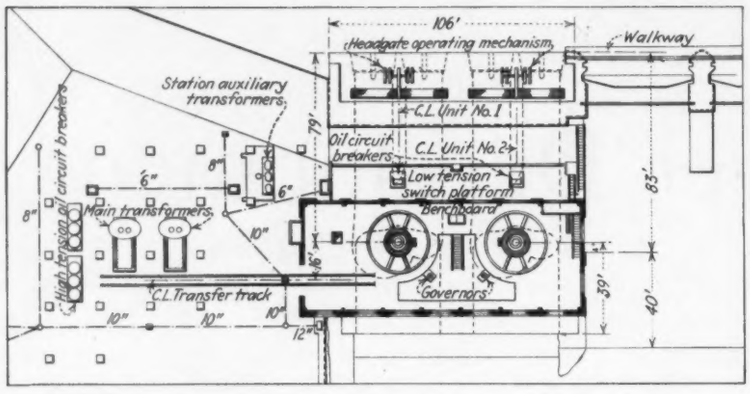
Beginning with the power plant furthest upstream the stations situated on the Catawba River are as shown in the following table:

Name of Hydro Station	Rated Capacity of Station, Kilovolt-Amperes
Bridgewater	25,000
Rhodiss	31,875
Oxford	45,000
Lookout Shoals	23,400
Mountain Island	75,000
Catawba	75,000
Fishing Creek	37,500
Great Falls	30,000
Dearborn	56,250
Rocky Creek	30,000
Cedar Creek	56,250
Wateree	70,000
Total	555,275

The Bridgewater, Rhodiss and Oxford stations, located in the upper region of the Catawba River, have a large storage capacity behind them which supplies the deficiency in power of the stations further downstream during low water seasons. The Duke Power Company operates a number of power stations on other streams contiguous to the Catawba River and the aggregate installed capacity of all hydro plants is 658,082 kva. In order to have an unfailing supply of power even during extreme dry seasons, such as occurred in the Piedmont section of the Carolinas in 1925, these hydro plants are operated in conjunction with a number of steam power plants having an aggregate installed capacity of 244,313 kva.

The total generating capacity of the entire system is 902,395 kva. and the power is fed into a transmission system consisting of approximately 3,000 miles of circuits, of which more than 50 per cent are 100,000-volt steel tower lines.

Oxford station is located on the right bank of the Catawba River, 12 miles northeast of Hickory, N. C. When full, the storage reservoir forming part of the



Equipment layout requires no provision for station expansion

development covers an area of 4,110 acres and the water backs to the tailrace of the Rhodiss station; the flow from the Oxford station discharges into the pond of the Lookout Shoals station.

The maximum gross head thus obtained is 90 ft. and the minimum gross head is 65 ft., considering a drawdown of reservoir level of 25 ft. The mean station head is 84 ft. The estimated drainage area is 1,250 square miles.

Favorable conditions, as to topography and geology, for the location of a comparatively high masonry spillway of sufficient length to take care of floodwaters and of a bulkhead with power house immediately below it existed at the foot of the Oxford Shoals of the Catawba River.

The spillway contains ten steel floodgates of 45 ft. clear width and 25 ft. height each. They are of the Stoney roller gate type and are equipped with "U" type water seals. Two motor-operated gantry type traveling hoists are provided for the operation of the floodgates and each hoist is designed to raise or lower a gate at a speed of 3 ft. per minute with water level 1 ft. above the top of the gate. All motors are of the fully inclosed Marine type, wound for 230 volts direct current, and the starters are of the drum controller type.

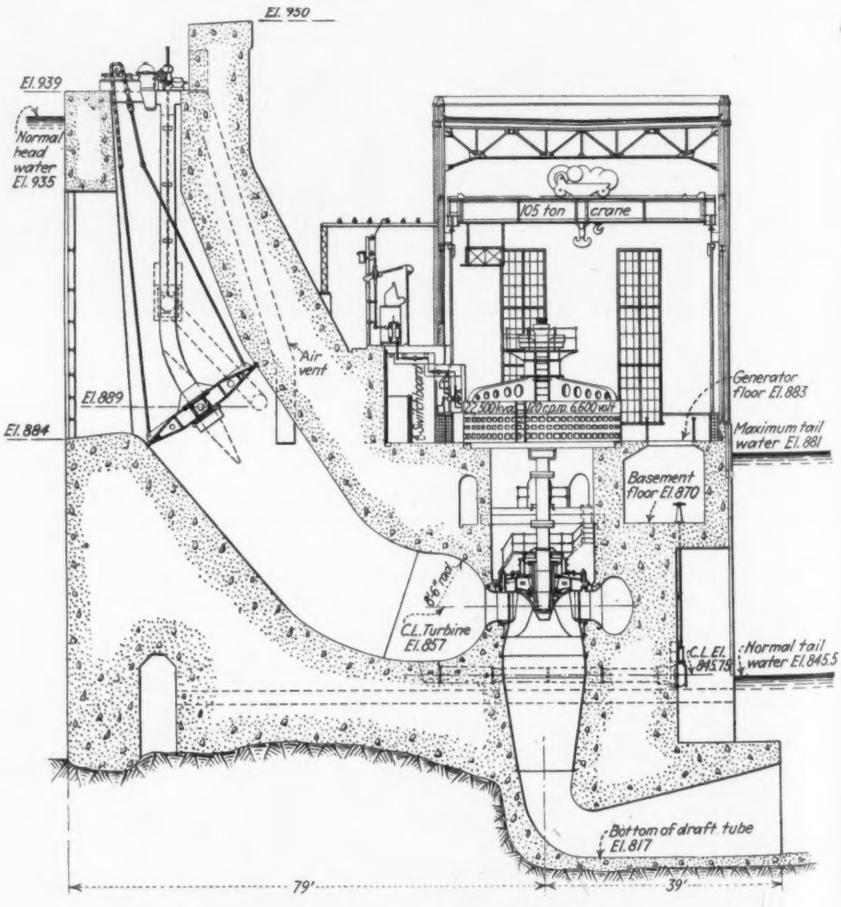
The rack structure forming the upstream portion of the power house bulkhead contains eight rack sections 9 ft. 9 in. wide, each, by 39 ft. high, which are built of structural steel and arranged in a vertical position. The spacing of the 6-in. wide by $\frac{3}{8}$-in. thick rack bars is $4\frac{1}{2}$ in. on centers. Four sections are in front of the water inlet to each of the two turbines installed.

The power house substructure forms the downstream extension of the bulkhead. It is built of concrete masonry, strengthened by reinforcing steel around each wheel chamber. The intake to each turbine flume consists of two openings, which are controlled by rectangular gates of the butterfly type, each 15 ft. 9 in. wide by 21 ft. $9\frac{1}{2}$ in. high. These gates are built up of a cast-steel center girder with cast-iron wings attached thereto by means of shrink links and machine bolts and are similar in construction to those used successfully in a number of power plants of the Duke Power System. In distinction to individual operating mechanisms for each headgate as installed in the older power plants the layout for the Oxford station calls for but one operating mechanism to serve the two gates controlling the openings into which each turbine intake is subdivided.

Each operating mechanism is designed to close both gates simultaneously with no back pressure and to open same, with the penstock filled with water by use of bypass valves, in four minutes. In addition each mechanism is capable of opening one gate at a time under the severe condition of full water pressure against the gate and the penstock empty. To this end the operating mechanism is provided with cast-steel jaw clutches, by means of which any one gate can be disconnected. The electrical equipment for each hoist consists of one inclosed and weatherproof compound-wound, direct-current, 230-volt motor.

A weatherproof push-button control station for opening, closing and stopping the gates at any position is provided for each operating mechanism on top of the bulkhead, as is a non-weatherproof control station on the power house benchboard for distant closing of the gates in case of emergency, such as a possible runaway of the turbine.

The operating mechanism is connected with each gate by a combination chain and rod which has a 4-in. slack



Design allows for utilization of full-head plants upstream and downstream as governing factors

for overtravel. Moisture-proof limit switches for open and closed positions of each gate, as well as two limit switches so arranged that the overtravel limit switch of that gate which is disconnected from the operating mechanism by opening the clutch becomes inoperative, are provided.

An auxiliary hand-operating device can be engaged by means of a clutch in case the electric power supply should fail.

The generator floor is 37.5 ft. above the normal tailwater level for protection against extreme high water. No basement windows are provided, but by means of a large well in the generator floor the necessary cooling air for the generators and sufficient natural light are obtained. This arrangement, furthermore, permitted placing the turbine governors in the basement, since a direct view of the actuators may be had by the benchboard operator.

The power house superstructure is built of brick, incasing the structural steel frame that supports the roof trusses and the steel runways for the 105-ton capacity electric crane in the generator room. The outside of the building consists of red tapestry brick with limestone trimmings and the interior of the station is covered with plaster and finished with a coat of paint. The generator floor and the inside face of the walls up to a height of 4.5 ft. above the floor level are covered with glazed tile. The large window sashes are built of steel and the roof consists of reinforced gypsum slabs resting on steel purlins, the top of the slabs having a finish of tar and gravel.

Hydraulic Turbines

The two turbines installed in the power station are of the vertical shaft, single runner, Francis type and are set in concrete spiral casings. When operating at a speed of 120 r.p.m. each turbine is guaranteed to give the following powers and efficiencies:

Head in feet	90	85	80	70
Maximum horsepower	28,000	26,200	24,100	22,002
Efficiency in per cent at full load	87.5	87.5	87.5	87.0
Efficiency in per cent at best load	91.5	91.5	91.5	91.5

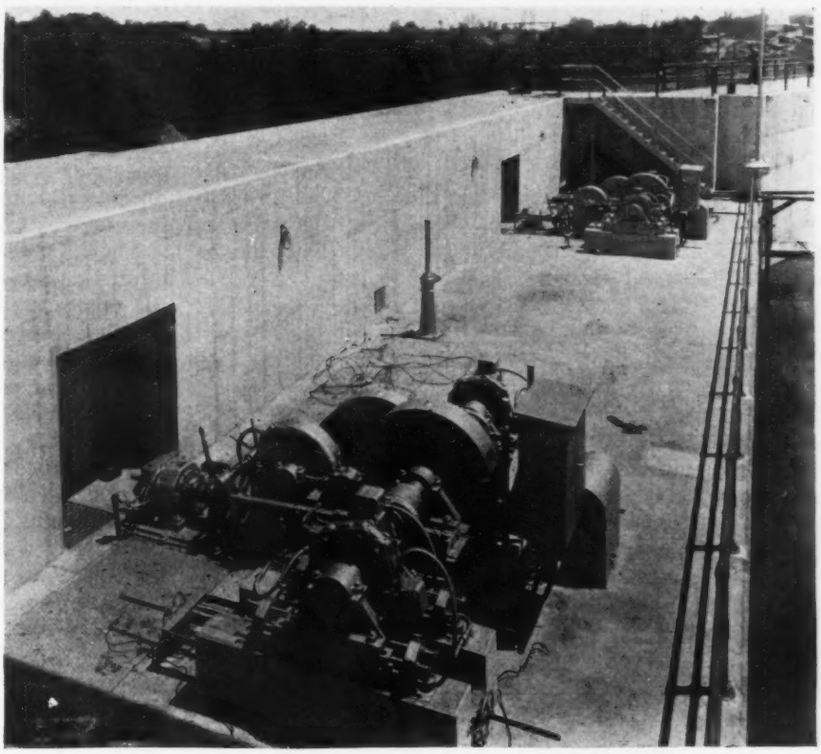
The draft tube formed in the concrete substructure is of the improved elbow type and an automatic air vent is provided on the crown plate of the turbine to supply air at low gate openings and when the generator is operated as a motor.

To prevent erosion of the concrete, which may be caused by the water discharging at high velocities from the throat of the turbine, the vertical section of the draft tube below the foundation ring is lined with ½-in. thick plate steel. The outside of the liner is provided with angle stiffeners and steel-reinforcing "Z" bars, which are anchored in the surrounding concrete masonry.

The governor equipment is installed in the basement of the power house and each turbine has its individual oil pressure governor, with the piping so arranged that the governors may be operated as an interconnected system. The governor fly balls are driven by an alternating-current motor wound for 220 volts, three phase, 60 cycles, receiving its current direct from the generator of the unit which is to be regulated. Two 200-watt potential transformers are provided to step down the generator voltage.

An automatic shut-down device designed to shut the turbine gates and stop the unit from the station switchboard is installed for each turbine.

The governor is adjusted to close and open the gates in 2½ seconds and the guaranteed speed regulations, based on a flywheel effect of 11,000,000 lb.-ft. squared in the rotor of the generator, a normal speed of 120 r.p.m. and a gross head of 90 ft., are as follows:



Headgate operation is secured by outdoor equipment mounted on power house bulkhead

Sudden Load Changes, Hp.	Speed Variation	
	Load On, Per Cent	Load Off, Per Cent
28,000	....	29.1
21,000	24.0	19.5
14,000	14.1	11.4
7,000	6.1	4.8
2,800	2.1	1.8

In view of the fact that the power generated in the Oxford station is fed into the transmission lines of a large power system these speed variations are considered satisfactory. Furthermore, the actual flywheel effect of the generator rotor is 18 per cent greater than that specified by the turbine manufacturer.

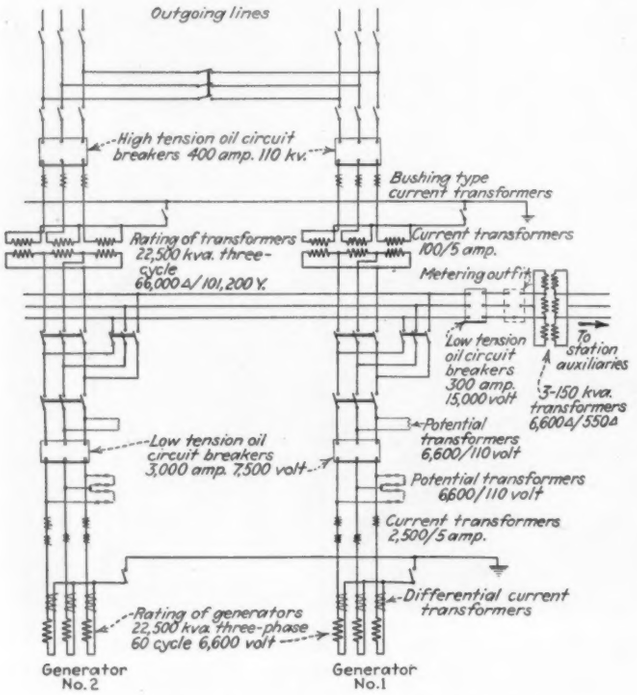
Each of the two generators directly connected to the turbines has a normal continuous full load rating of 22,500 kva., or 18,000 kw. at 80 per cent power factor, 6,600 volts, three phase, 60 cycles, 120 r.p.m. At this

rated load the increase in temperature is guaranteed not to exceed 55 deg. C. in any part of the generator. The exciter is mounted on a stub shaft bolted to the main generator shaft and the rated capacity is 175 kw. at 250 volts, and at this rating the temperature rise of the exciter is not to exceed 50 deg. C. For voltage regulation a motor-operated exciter field rheostat is supplied, and no rheostat is used in the generator field. The thrust bearing on top of the generator is of the Kingsbury type and its housing is provided with water-cooling coils.

The efficiency of each generator when operating at the normal continuous rating and at 80 per cent power factor is:

Full Load	Three-Quarter Load	One-Half Load
96.8 per cent	96.5 per cent	95.8 per cent

The oiling system of each generating unit is self-contained. A gear pump located in the oil pan of the


Outgoing lines
High tension oil circuit breakers 400 amp. 110 kv.
Bushing type current transformers
Rating of transformers 22,500 kva. three-cycle 66,000 Δ/101,200 Y.
Current transformers 100/5 amp.
Metering outfit
Low tension oil circuit breakers 300 amp. 15,000 volt
To station auxiliaries
3-150 kva. transformers 6,600 Δ/550 Δ
Potential transformers 6,600/110 volt
Low tension oil circuit breakers 3,000 amp. 7,500 volt
Potential transformers 6,600/110 volt
Current transformers 2,500/5 amp.
Differential current transformers
Rating of generators 22,500 kva. three-phase 60 cycle 6,600 volt
Generator No. 2
Generator No. 1

Simplified layout minimizes construction factors

lower guide bearing is driven by a gear fastened to the generator shaft. It forces the oil upward to a small reservoir, whence, by means of a parallel system of piping, the lubricant flows by gravity to the thrust bearing and the two guide bearings. The overflow from the thrust bearing and the drainage from the guide bearings are carried back to the lower reservoir for recirculation through the lubricating system.

The generator armature is star-connected, both ends of each phase being brought outside of the frame on the upstream side of the generator for differential protection. Each neutral tie has a disconnecting switch and the neutral bus, consisting of a ½-in. copper tube supported by porcelain insulators, is carried to the common station ground bus.

A diagram of electrical connections of the power house and outdoor station is shown in an accompanying figure and it will be noticed that each generator feeds its own transmission line under normal operating conditions. The generator leads to the low-tension oil circuit breakers and the transfer buses are built up of three 4-in. x ¼-in. copper bars per phase and the extension of the generator leads from the low-tension oil circuit breakers to the connections with the main transformers consist of 2½-in. extra-heavy, iron pipe size copper tubing per phase, which latter arrangement permits a much larger span between supports.

The main three-phase, 60-cycle, oil-insulated, water-cooled transformers are of the outdoor type and have the same capacity as the generators. The energy is stepped up from 6,600 volts delta to 101,200 volts star. The transformer bases are equipped with flanged wheels and by means of a transfer truck each transformer can be rolled into the power house for inspection and repair if necessary.

The triple-pole, single-throw generator oil circuit breakers are of the indoor type with weatherproof housings and the rating of each breaker is 3,000 amp. at 7,500 volts. A 220-volt, direct-current, motor-operated mechanism is provided for each breaker. The three-pole, single-throw 110,000-volt, 400-amp. high-tension oil circuit breakers are of the outdoor type and their interrupting capacity is 500,000 kva.

The benchboard for the control of the generators is located on the generator floor between the two units near the upstream wall of the building and in front of the large floor opening, through which access to the basement is obtained besides giving a view of both governors. The exciter field switch panels and rheostats are arranged in the basement below the generator-control benchboard.

The vertical switchboard consists of five panels, two of which control the motor-generator sets, the other panels containing the relays, recording ammeters, voltmeters and watt-hour meters. It is centrally located in the space below the low-tension switch platform and near the benchboard.

A 250-volt storage battery of 56 amp.-hr. floating on the direct-current circuit of the 1.5-kw. motor-generator set is provided in the basement of the power station. It is capable of operating the control of the oil circuit breakers, the dead lights on the benchboard and switchboard and the station emergency lights during any reasonable interval of interruption.

The station auxiliary bus, consisting of one 2-in. x ¼-in. copper bar per phase, is connected to a bank of three single-phase, 150-kva. transformers stepping down the current from 6,600 volts to 550 volts. To have a lower fire insurance rate these transformers were placed outside of the power house. From this bus one 150-kw. motor-generator set supplying direct current to the power house crane, headgate and floodgate hoist motors, and to a generator field in case of emergency, one 1.5 kw. motor-generator set supplying direct current to the storage battery, two station air compressors, one governor air compressor and two water supply pumps are operated. By means of a 25-kva., single-phase, 550-volt to 110-volt transformer the energy is provided for station, yard and spillway lighting.

Final closure of the spillway was made in the latter part of March, 1928, and the flow of the Catawba River impounded in the reservoir. Operation of the plant commenced on April 5, 1928, when the water surface of the reservoir was 30.3 ft. below the top of the floodgates in closed position; the initial operating head was 59.7 ft.

The entire power development was carried out by the construction department of the Duke Power Company.

Corona Related to Failure of Cable Terminals

Internal flashovers in highy stressed air spaces involve terminal explosions. Displacing air voids with compound solves problem

By S. B. Clark and F. O. McMillan*

FOR SOME time the Northwestern Electric Company has experienced cable terminal failures on its 13,200-volt cables, some of which have caused serious service interruptions and involved losses amounting to several thousand dollars. Seeking to improve conditions, 25,000-volt terminals were used on 13,200-volt cables, but even with this terminal rated at almost twice the operating voltage failures continued and terminals did not have the desired degree of reliability.

Failures usually occur on terminals that have been in service for some time and almost invariably the porcelain body is blown to bits by the explosive violence of the failure. In some instances the oil circuit breakers clear the initial fault, and upon reclosing the breakers service is restored with no indication of trouble on the circuit. Also, it has been found that in some cases the porcelain insulation is blown away and the insulation on the end of the cable left projecting above the metal body of the terminal is sufficient to maintain service for a short time under favorable weather conditions. In some cases all evidence showing the cause of the failure was destroyed, except the general characteristics as already mentioned.

*Superintendent underground department, Northwestern Electric Company, Portland, Ore., and professor of electrical engineering Oregon State College, Corvallis, Ore., respectively.

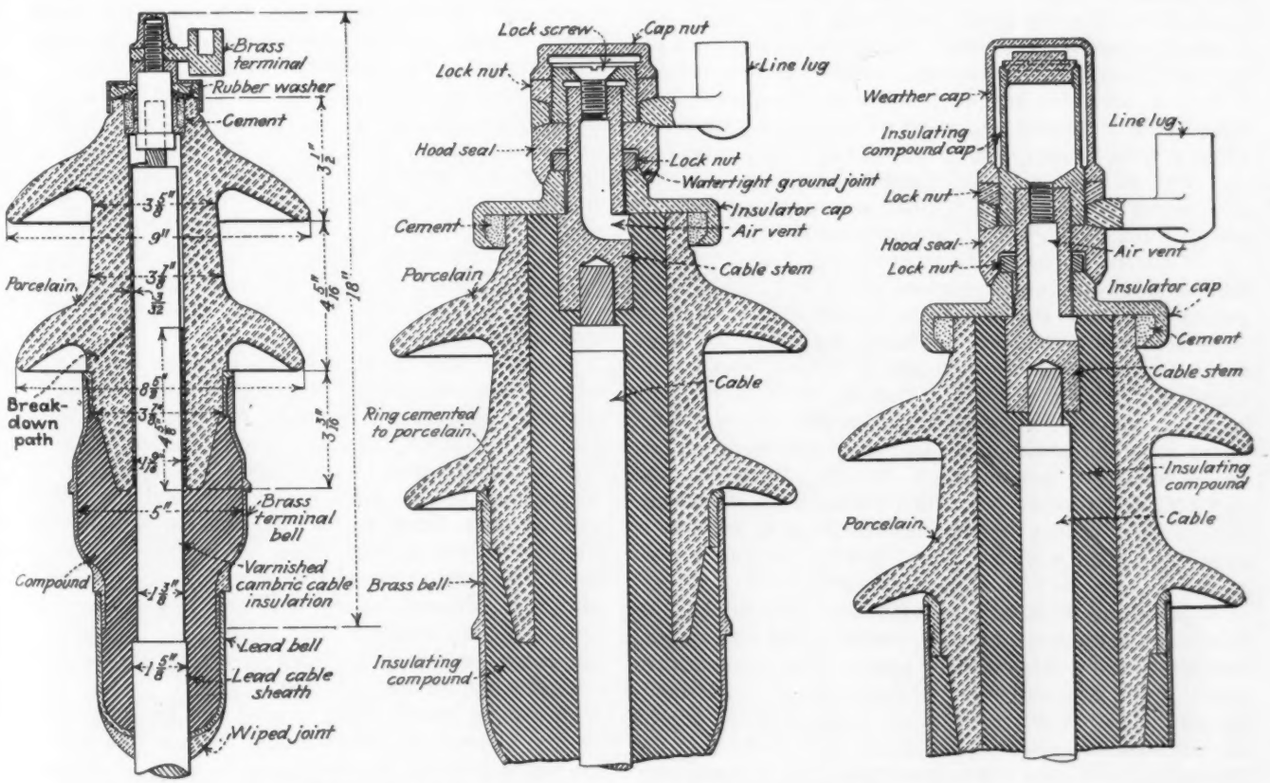
For this reason it was thought advisable to subject terminals similar to those in service to a high-voltage laboratory test.

Three terminals of the type shown in Fig. 1, rated at 25,000 volts and with 250,000-circ.mil, 13,200-volt cable tails attached, were sent to the Oregon State College high-voltage laboratory. In preparation terminals No. 1 and No. 2 were assembled according to standard practice, while terminal No. 3 was assembled in a somewhat different manner. During tests all high voltages, such as flashover and corona forming, were measured by means of a 250-mm. sphere gap conforming with A.I.E.E. standards. Frequency was 60 cycles in all cases.

Results of Tests

Due to the fact that a number of terminal failures had occurred in localities subjected to smoke from oil-burning locomotives it was thought that the accumulation of carbon on the porcelain might reduce flashover voltage of the terminals. To investigate this condition the porcelain of terminals No. 1 and No. 2 was covered with a heavy coating of carbon from a fuel oil smoke generator. Voltage was applied to terminal No. 1 until flashover occurred at 124 kv. Upon second test the terminal did not flashover outside the porcelain shell, but inside from the bare conductor through the porcelain shell at a point just below the bottom petticoat, where it punctured the porcelain and went to ground. This failure and its significance will be discussed later.

Continuing with the investigation of the influence of the carbon deposit, terminal No. 2 was treated to prevent internal flashover in a manner to be described later and flashover tests were made on it with and without the carbon deposit. Seven consecutive flashovers were made



Porcelain cable terminals used in investigation of explosive failures

Fig. 1—Sectional view of cable terminal subjected to test, showing small air space only partially filled with compound resulting in breakdown due to highly stressed air.

Fig. 2—Improved type of terminal with large space provided for compound between cable and porcelain shell has advantages over the standard design.

Fig. 3—Experimental terminal design showing attachment of compound cup to insure against voids after terminal is in service.

on the carbon-coated terminal before the cable failed. The average value of these flashovers was 120.9 kv., the maximum value was 122.1 kv. and the minimum 120.0 kv. The fault was cut out of the cable stub and the carbon deposit thoroughly cleaned off the terminal. Three flashovers were obtained before the cable punctured. The average value of flashover clean and dry was 120.4 kv., the maximum value 121.1 kv. and the minimum 119.8 kv. The interesting thing about these data is that the flashover of the terminal is for all practical purposes the same, regardless of whether the terminal is coated with carbon deposit or clean. The explanation for this phenomenon lies in the fact that the very minute carbon particles are in very poor contact with each other and the carbon deposit acts as a very high resistance leakage path over the cable terminal, resulting in a better voltage distribution over the terminal than when clean. This causes the flashover voltage to remain practically the same as or slightly better than for a clean terminal. Upon completing the carbon deposit tests it was concluded that the smoke deposits were not the cause of terminal failures.

Internal Corona Formation

Immediately after the failure of terminal No. 1 it was taken apart and the path of the internal flashover traced. It was discovered that there was an air space of approximately $\frac{3}{32}$ in. between the cable insulation and the inside of the porcelain body of the terminal. This thin layer of air in series with the high permittivity varnished cambric insulation of the cable and the porcelain of the terminal is subjected to high dielectric flux density, and consequently high voltage gradients at comparatively low terminal voltages. To determine the value of voltage to ground at which corona forms in this air space two holes were drilled vertically through the cement at the top of terminal No. 2. Through these holes rubber hose was inserted to the air space inside the terminal. These rubber tubes formed a stethoscope, with which the voltage to ground at which corona formed could be accurately determined. The average value of voltage to ground at which corona formed in the bushing was found to be 22.7 kv. This is 157 per cent of rated voltage to ground and 298 per cent of voltage to neutral, at which the terminals are operating on the Northwestern system.

The internal flashover of terminal No. 1 and the formation of corona inside terminal No. 2 at comparatively low voltage shows that the weakest point in the design of these terminals, and very probably the cause for most failures in service, is the presence of the air column surrounding the cable in the porcelain body above the pothead compound. The breathing action of terminals under favorable atmospheric and temperature conditions causes moisture condensation on the inside of the terminal, still further reducing its reliability. The conclusion, then, is that the only safe terminal is one that is completely filled with compound and has no internal air space subjected to high-voltage gradients.

In preparing terminal No. 3 for test, after filling with compound in the usual manner, forced filling was applied completely to fill this small air space. The terminal prepared in this way withstood 40 flashovers without showing any signs of distress. After tests were completed the terminal was broken open and it was found that the compound completely filled every space. It would appear that the solution of terminal failures of this type and voltage was found when using the pressure method of filling. Experience shows that all filling compounds used in sizable quantities have a tendency to contract, either increasing in density or migrating, thereby leaving voids within the filled space. A number of terminals have been installed on the Northwestern system using the pressure method of filling, but after a time in service this small shrinkage allows the compound to settle out, resulting in an air void which has caused terminal failures.

It would seem from this investigation that some means should be provided to fill this void or cavity at the top of the porcelain insulator permanently. An advance in this direction has been made by the manufacturer of a new terminal design, Fig. 2, which allows more clearance between cable insulation and porcelain shell, a positive mechanical method of preventing air from entering the top of the terminal after assembly and a means for completely filling the top of the terminal with compound. This new design, however, does not provide against voids left by contraction or migrating of the filling compound while the terminal is in service. A cross-section of a terminal top compound reservoir which acts only as a container for filling compound and compensates for contraction and migration of the compound used in the original filling is shown in Fig. 3. If this method of eliminating air voids proves satisfactory after tests it will be used on the more important 11,000-volt lines of the Northwestern Electric Company.

The writers wish to acknowledge the assistance of E. F. Pearson, electrical engineer for the Northwestern Electric Company, in this investigation and to thank him for many valuable suggestions.

Tree Trimming and Customer Relations

OBLIGATION to furnish good service and the hazard to service from tree contacts with overhead wires constitutes, quite aside from the operating aspect, a rather serious customer relations problem, according to a late report of the committee of the Great Lakes Commercial Section, N.E.L.A., on that subject. The problem arises from the skillfulness, or rather the lack thereof, with which tree trimming is quite frequently done and the attitude adopted by the utility toward property owners or others having interest in the trees. The report instances the practices of companies that have been successful in minimizing the service hazard due to tree contacts by adequate trimming and have, at the same time, retained public regard by the manner in which the tree trimming was handled.

The first consideration is that trimming be done properly. It cannot be done properly by untrained men. A trimming gang should be under the close supervision of a man who knows trees, who knows that some species—such as cottonwoods, box elders and soft maples—may be trimmed at any time of the year, and that others—such as oaks, hickories and hard maple—should not be trimmed or cut heavily when leaves are opening. He should be careful to see that saw cuts and wounds are painted to forestall rot and that the trimmers use ladders instead of pole climbers. He should have a good eye for symmetry so that a trimmed tree will not be left an unsightly blot on the landscape.

In case no special gang is used and trimming is done by line crews each crew should include one man who has had special training in tree trimming. At the present time Syracuse University and the University of Wisconsin offer short courses on this subject and other universities are planning similar courses.

The legal rights of the utility company are best kept

in the background in all negotiations with individuals and governmental bodies in regard to trimming. It may be necessary to invoke these rights, if they exist, in extreme cases, but the interest of the utility is better served by amicable agreement if such is at all possible.

Permission of the owners or others interested should always be secured in writing before any tree is touched. Some companies find that permission is facilitated by showing photographs of trimmed trees to owners and by judicious use of explanatory publicity when the matter affects a municipality or other body.

State laws differ widely on the subject of tree trimming. In Wisconsin a public utility is prohibited by statute from destroying, trimming or otherwise injuring any shade or ornamental trees on the highways except with the consent of the highway commission. Some lawyers are of the opinion that a public utility cannot condemn a tree under the power of eminent domain. The laws vary and are capable of different interpretations, but, generally speaking, the permission of property owners must be obtained and there are certain limitations on the powers of a company when it comes to trimming trees on public ways.

The procedure of some companies includes, in addition to the securing of permission, the notification of parties interested just before trimming is to be done and with it an invitation to oversee the job if desired. After the job is done and cleaned up by the removal of limbs and smaller débris, the owners or others are asked to inspect the job and every reasonable effort is made to satisfy them.

Automatic Brake for Supersynchronous Motors

By M. P. Bailey
Industrial Control Engineering Department, General Electric Company

ONE of the first installations of supersynchronous motors fitted with automatic motor-operated brakes has just been put in service at the Volunteer Portland Cement Company's plant at Knoxville, Tenn. The supersynchronous motor, contrary to conventional synchronous motor design, is built in such a way that the stator frame can revolve. These motors are applied where the required starting torque is excessive.

In starting, the stator frame is brought up to speed and phased-in while the rotor and load are stationary, then a powerful band brake is applied to the stator frame periphery and the stator comes slowly to rest, while the rotor is just as slowly coming up to speed together with its driven machine.

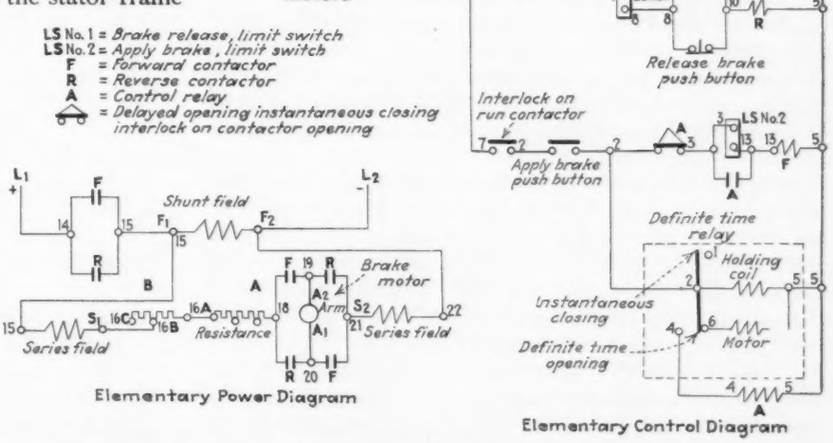
The power demand upon the line and the mechanical stresses to which the driven mechanism is subjected depend upon the rate and manner in which the load is accelerated, and this motor-operated brake, by bringing the stator to rest in a smooth, deliberate manner, accelerates the driven machine without excessive peaks of starting current or shocks to the machinery.

Starting current regulates rate at which frame of supersynchronous motor is brought to rest

The rate of load acceleration is determined by the amount of weight on the lever, clearly shown at the right of the braking motor. The control panel provides for all contingencies.

The brake is put into operation by a push button and is another step in the direction of taking the personal element out of electric motor control. The control panel illustrated in the accompanying diagram was designed to work in conjunction with the starting equipment to apply the brake and bring the rotor and load up to synchronous speed automatically.

Power and control circuits for automatic braking of supersynchronous motors



The closing of the run contactor and field contactor of the starting panel energizes the forward contactor of the new panel if the "apply brake" button has been pressed. This starts the brake motor to tightening the brake. At the same time a definite time relay is energized and starts timing. When the brake application is sufficient to cause the lever arm to rise and trip the limit switch, the motor stops until the definite time relay trips and energizes the control relay. This causes the brake motor to set the brake tightly and stall. After a few seconds the interlock will open the motor circuit and leave the brake fully applied. To release the brake the operator presses the "release brake" button or trips out the main motor control. The brake motor is thus energized and releases the brake until a limit switch stops it in the "full released" position.

The Power-Cost Factor in Industry Location

By Ford Bates
Nebraska Power Company, Omaha, Neb.

HOW much or how little is the power salesman justified in stressing the advantage of cheap power? That power is an important factor in the modern industrial era is a well-known and generally accepted fact. But how important is it as an element in the cost of production? This question has been answered many times, but the answer seems a very easy one to forget. A number of years ago the Electrical World published an article on this subject in which was given a list of power-cost percentages classified by industry about as follows:

Industry	Ratio of Cost of Electric Power to Total Value of Product	Industry	Ratio of Cost of Electric Power to Total Value of Product
Stone, glass and clay	10.9	Textiles	1.3
Chemicals	8.1	Food	1.0
Iron and steel	5.7	Vehicles	1.0
Paper	2.4	Lumber	0.8
Railroad repair shops	2.4	Leather	0.6
Metals, except iron	2.2	Tobacco	0.2
Liquors	1.8	Miscellaneous	1.9

This compilation was made after a careful survey in a number of utilities. The average for all industries was 2.8 per cent.

Let us consider some other examples right in the Middle West. Flour, for example, a barrel of which is worth about $5, has a power cost per barrel of about 8 cents or 10 cents, or about 2 per cent of the value of the product. This percentage runs as low as 1 per cent in some mills. In one of the largest creameries in Omaha the unit electric power cost was a quarter of a cent per pound of butter, or less than six-tenths of 1 per cent.

One large bakery used $7,150 worth of power in 1927, including the operation of electric trucks for about half of the transportation. The production for the year totaled $1,200,000. Power represented almost six-tenths of 1 per cent of the cost of every loaf of bread or cake produced. When a person takes a trip through the bakery and sees all the labor-saving equipment in mixers, proofers, conveyors, wrappers and the like, it is difficult to realize that power represents such a small percentage of the cost for making a leaf of bread.

A tire factory makes $150,000 worth of tires (factory cost) in one month with $1,300 worth of power—0.87 per cent. A meat-packing plant with a 1927 output valued at $58,000,000 has a power cost for the year of $136,000, less than one-quarter of 1 per cent.

Even in those industries in which power cost is relatively a large item, it is still not a major one. In artificial ice making power is only one-fourth or one-fifth the value of the company's product. In the production of oxygen from the air power represents about one-eighth of the total production cost. Electric steel making is one process in which power is a relatively costly item. A completely electrified steel foundry in Nebraska spends about $15 for all the electricity required to melt, refine, pour and anneal a ton of castings valued at about $160. This includes all of the foundry power and light as well as the charge for power requirements.

What, then, are the important advantages to be sought in the location of an industry? A chamber of commerce would probably list these advantages in the following order of importance:

1. Market.
2. Raw materials.
3. Transportation.
4. Labor.
5. Building site and costs.
6. Financial accommodations.
7. Utilities:
   (a) Power.
   (b) Water.
   (c) Gas.
   (d) Telephone.
   (e) Local transportation.
   (f) Miscellaneous.
8. City and state requirements:
   (a) Taxes.
   (b) Regulations, etc.
9. Civic features.

The first two factors are always much more important than all the others. Transportation is inseparably linked with raw material and markets, and freight may vary through comparatively wide limits.

For example, the operator of a large flour mill in Nebraska states that on freight the annual cost could easily be affected as much as $80,000 by the location of the mill in a less advantageous shipping point. Compare this with the annual power bill of the same mill of $35,000 to $45,000. Why, if its power costs were cut in two—and that, by the way, would give an unheard-of rate—the saving would be only one-quarter of what might be wasted if the transportation feature were unfavorable!

Similarly, the operator of another food-products plant, with an annual power bill of $23,000, says that a differential of as much as $50,000 a year in transportation could be realized by a slight change of location. The items of labor, building site and cost and financial accommodations also all have in more or less degree a greater effect on the cost of production than does the cost of electric power.

The proprietor of a wax-paper-products factory recently located in Omaha. He was asked what part the different features played in his selection of location, and he very quickly answered that market and transportation were the whole thing. Power was no factor at all. If it had cost three times as much or one-half as much, it would have had no effect on the choice.

The conclusion, then, may be drawn, that power cost is rarely an important factor in determining the location of industry. When other factors are about equal, however, favorable power rates are an inducement.

Many business men do not realize the relatively small importance of power cost. Evidence of low electric rates in a community is to them a good argument for location there. Then, too, it frequently is the case that the annual net profit of a concern is of an amount so comparable to the annual power bill as to be affected by it to no inconsiderable extent. This, of course, brings the matter right into the user's pocketbook, where its effect is very definitely noticed.

The chief use of the fact that power cost is a small element is in selling electricity in competition with another form of energy. Greater convenience, less damaged material, more freedom from the human element and safety considerations often turn the decision to the electric method rather than to a cheaper one, when the relatively small cost of either compared with the value of the product is shown and receives consideration.

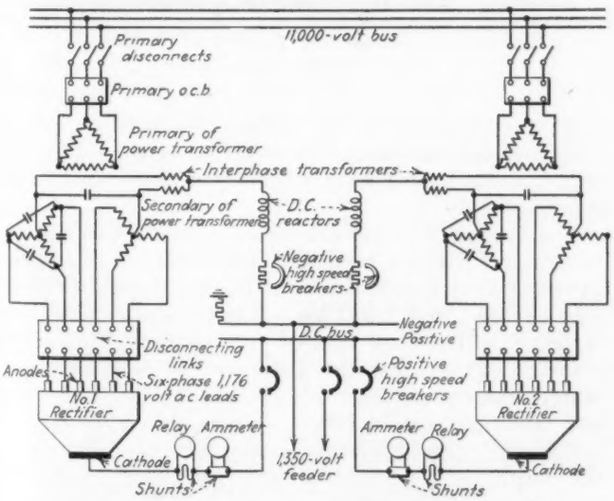
Performance of Mercury-Arc Rectifiers

Portland installation shows savings in first cost, floor space and operating costs. Little trouble experienced

By Verne Hansen
Assistant Engineer Portland Electric Power Company, Portland, Ore.

SPECIFICATION of 11,000-volt, three-phase, 60-cycle power to supply 1,350-volt direct current to the Portland terminus of the Oregon Electric Railway is being accomplished with two 750-kw. mercury-arc rectifier sets in the Jefferson substation of the Portland Electric Power Company. This is the pioneer installation on the Pacific Coast and the first of its kind west of Chicago. The power company's desire to supplant its 33-cycle supply with 60-cycle energy was largely responsible for the installation. It has permitted the railway to close its manual substation near Portland and take advantage of the operating economies which resulted.

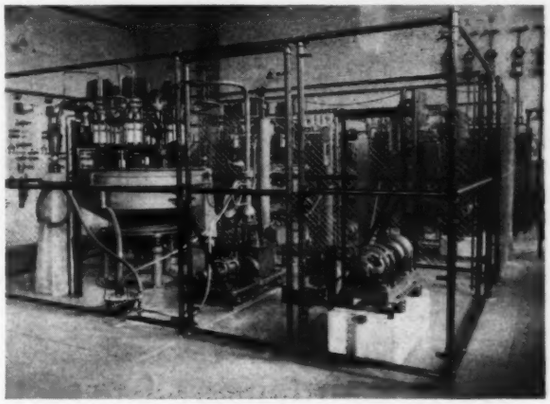
The proposal to install mercury-arc rectifiers appealed because the initial cost of apparatus, including switchboard, was approxmately 60 per cent of the cost of motor-generator sets and because of their high efficiency over a wide range of load and high overload rating. The over-all efficiency from 11,000-volt bus to d.c. busbars, including auxiliaries, according to the manufacturer, was above 95 per cent from half load to and including full load and above 92 per cent at one-quarter load and 150 per cent load points. The efficiency of the rectifiers has not been accurately determined in the field, but such checks as have been made indicate that it falls within the stated limits set by the manufacturer.



Schematic connections for two 750-kw., 1,350-volt mercury-arc rectifiers and outgoing feeder

These characteristics of the rectifier become of particular importance when the conversion apparatus operates under conditions which impose a low load factor, especially as in traction service. Based on a typical average daily load curve at Jefferson substation and the efficiencies stated above a saving of 1,146 kw.-hr. during 24 hours, or 418,290 kw.-hr. per year, can be effected by employing rectifiers instead of motor-generator sets. At the prevailing market price per kilowatt-hour this annual saving amounts to several thousands of dollars. Other considerations in favor of the rectifier installation were the freedom from noise and vibration, less expensive foundations, less floor space required and the simplicity and speed of starting operations.

Two 750-kw. General Electric rectifiers, including high-speed breakers and switching equipment, are involved. Each rectifier tank is of the six-anode type, giving full-wave rectification. The two units are entirely independent of each other, so that either or both may be operated as occasion demands. The rectifier transformers are in an adjoining room and are water cooled.



One of two 750-kw. mercury-arc rectifier sets serving Oregon Electric Railway

Water cooling was selected because a good supply of pure, clean well water is available.

Each rectifier unit is required to deliver 1,350 volts at no load and 1,250 volts at full load. Compounding is provided by a direct-current saturated-core interphase transformer which interconnects the two secondary "Y" windings in each rectifier transformer. The direct current for saturating the core is derived from the load current. By varying the direct-current saturation of the interphase transformer in proportion to direct-current load, the required degree of compounding is obtained.

To put the rectifiers on the line requires only the time to close machine disconnects, inspect vacuum, start arc-striking motor-generator set, close high-tension oil switch and high-speed breakers. Disconnecting a set from the line is just as simple and speedy. Successful operaton depends primarily upon maintaining a vacuum within the rectifier tank of not more than three microns and the prevention of deposits of mercury near the anodes. Poor vacuum and mercury deposits on the anodes are the prevailing causes of arc-backs within rectifiers.. To maintain the vacuum the mercury condensation pump is operated continuously and is kept hot by means of a 500-watt, 110-volt heater immersed in the mercury well in the base of the pump. To prevent deposits of mercury on and near the anodes each anode is equipped with a 150-watt heater, which is energized during very light-load periods and whenever the unit is shut down. These heating units are supplied with power from the auxiliary station supply through insulating transformers.

Three short interruptions due to arc-backs occurred in one day shortly after the rectifiers went into regular operation and were traced directly to a burned-out anode heater. Since the new anode heater has been installed no arc-backs have occurred. Cooling of the rectifier

tank is automatically provided by means of thermostatically controlled water valves with thermal elements in the cooling water jackets. These regulating valves maintain a cooling water temperature of 95 deg. F. in the jackets. Very little cooling water is required.

Any possibility of telephone interference due to ripples in the direct-current potential has been eliminated by the use of resonant shunts, each consisting of inductance and capacitance placed between the positive outgoing direct-current feeder and ground. The undulated wave form of the rectifier current is first smoothed out considerably by a reactor in the negative lead, but certain alternating-current residuals remain. In this installation of the sixth, twelfth and eighteenth harmonics of the 60-cycle fundamental wave were fairly high in percentage value and caused disturbance to nearby telephone circuits. Since the installation of resonant shunts at the substation these harmonics have been by-passed to ground and no further telephone interference has occurred. No interference with radio reception has been found. Extensive tests made at the factory prior to shipment to determine whether or not radio reception would be affected proved that receiving sets could be operated in the vicinity of rectifiers without local interference.

Static Condensers Correct System Power Factor

By William S. Hill

General Superintendent
Grays Harbor Railway & Light Company, Aberdeen, Wash.

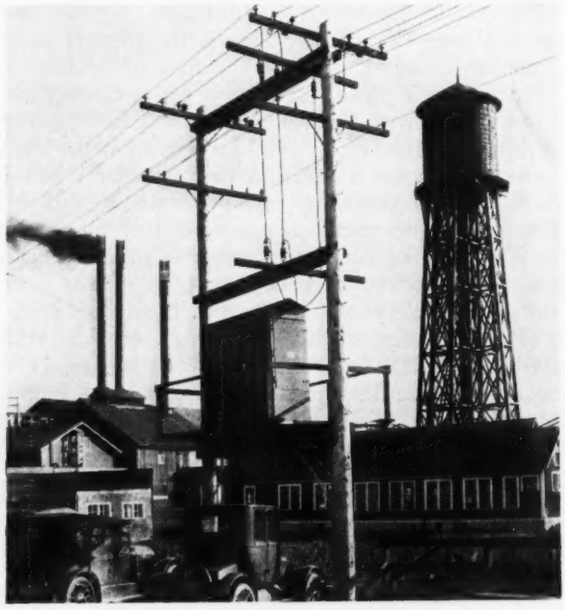
LOW power factor, caused largely by induction motor load in saw-mills, led the Grays Harbor (Wash.) Railway & Light Company to make a careful study of a satisfactory means of raising system power factor. The company has never had a power-factor clause in its rates and after weighing all factors decided that increase in generator capacity, reduction of losses and better voltage regulation would justify it in correcting power factor at its own expense.

A study of the application of synchronous condensers and capacitors was made, a number of factors entering into the choice of one of the two types. In the accompanying table a comparison is made for 2,000 kva. of corrective capacity, assuming that the synchronous condenser would be located at the power plant and that capacitors would be located at customers' premises. It will be seen that the total annual saving in favor of the capacitors is $5,697. This amount capitalized at 15 per cent is $38,000, which is the additional amount the company would be justified in spending to install the capacitors. Since the difference in cost of the two methods was only $24,000, it was decided to install capacitors. Moreover, a synchronous condenser would have required an addition to the power plant building, which is not included in these figures.

COMPARATIVE DATA ON SYNCHRONOUS CONDENSER AND CAPACITORS FOR 2,000 REACTIVE KILOVOLT-AMPERES

	Synchronous Condenser	Capacitors
First cost	$10,000	$34,000
Cost per kilovolt-ampere	$5	$17.50
Internal losses, per cent	3 to 4	0.25
Total internal losses, kilowatts	75	5
Annual losses for 24-hour operation, kilowatt-hours	683,280	43,800
Annual saving at 5 mills per kilowatt-hour	.....	$3,197
Annual saving in feeder losses, kilowatt-hours	.....	500,000
Annual saving in feeder losses at 5 mills per kilowatt-hour	.....	$2,500
Total annual saving	.....	$5,697

Tests were made at industrial plants and power factor was found to average from 45 to 60 per cent. It was decided to install six 300-kva. capacitor units, four rated at 440 volts to be installed on the secondary side of transformer banks and two rated at 4,000 volts to be installed directly on 4-kv. feeders. The accompanying illustration shows one of the latter installations. By installing capacitors out on the lines the correcting influence was obtained on the primary feeders as well as the generator, increasing the capacity of the entire system, whereas a synchronous condenser would correct the generator only.



300-kva. capacitor on 4,000-volt feeder for power-factor correction

System power factor was raised from 64.4 to 82.1 per cent, better voltage regulation has resulted, installation of larger transformer banks at two customers' premises was obviated and 1,300 kw. of generator capacity was reclaimed. The total cost of the capacitor installations was $31,500, so that the 1,300 kw. of additional generator capacity cost only $24.25 per kilowatt. This does not take into consideration, either, the investment in boiler and turbine capacity rendered non-productive by the large reactive load on the generator before the capacitors were installed.

A calculation of annual kilowatt-hour savings showed the following: 5,000-kw. generator I^2R loss, 66,283 kw.-hr.; 50-kw. exciter I^2R loss, 3,504 kw.-hr.; 50 kw. less excitation required, 54,801 kw.-hr.; line loss, 500,000 kw.-hr., or a total of 624,588 kw.-hr. per year. Assuming a busbar cost of 5 mills per kilowatt-hour, which is conservative, this energy saving amounts to $3,122.74 per year, or a return of 10.1 per cent on the investment of $31,500 in capacitors.

Based on these showings the company feels well satisfied with its first installation of capacitors for power-factor correction.

What Size Substations?

Factors to be considered in determining economic size. Practices of utilities. Method of analysis developed upon basis of interrelation of system elements

By L. G. SMITH*

Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

IN DETERMINING the economical size of substations, three major considerations are involved, each of which presents various problems of economy in itself: First, design and cost of the transmission system; second, design and cost of substations, and, third, the layout and cost of the distribution system.

Obviously, the cost of the transmission system will vary with the voltage and the size and capacity of the transmission cables. Moreover, the size of the substation used materially affects the cost of the transmission system, in that spare transmission capacity must be assumed to each substation. The choice of voltage and size of cables also depend upon the amount of energy transmitted and the distance of transmission.

The substation cost is a function of the transmission and distribution voltages and the capacity of the transmission and distribution cables. Moreover, the size and type of transformers used have a direct bearing on the cost of the substation. In small substations single-phase transformers with a single transformer spare may be the economical arrangement, whereas in large substations, using three-phase transformers, it may be necessary to have an entire three-phase unit as a spare. Furthermore, with certain relations between transmission and distribution voltages auto-transformers may prove economical. Whether or not the substations are installed outdoors also has a direct bearing on the substation economy. Another consideration in substation design is whether or not a high-tension bus is used or the transformers are connected directly onto the incoming transmission cables. Apparently the practice of using group regulation instead of individual regulators on each outgoing distribution feeder is becoming more popular. Undoubtedly there is a decided economy in such practice, the chief difficulty being the grouping of feeders having approximately the same load and length. The type and cost of building and land also has some influence in determining the economical size.

**Based on material compiled by substation sub-committee of the electrical apparatus committee, N.E.L.A.*

Effect of Cable Length

With a normal type of radial feed distribution system, where the distribution cables run from the substation to a feeder point approximately in the center of each feeder area, about the only cost that varies with the size of substation for given load density is the cost of the cable from the substation to the point fed; the cost of branch mains, distribution transformers and secondaries varies only with the load density, the substation size having no appreciable influence. As in the case of the transmission system, there is an economical voltage and size and ca-

Table I—Outline of System Design as Interrelated with Distribution System Design

I.—Comparison based on system as an inclusive entity.
- A. Economy determined by:
  1. Fixed charges on plant investment.
  2. Cost of losses.
  3. Operating costs.
  4. Maintenance costs.

II—Transmission System
- A. Voltage of transmission:
  1. Size of substations, i.e., amount of blocks of power.
  2. Cost of generating station switching equipment.
  3. Cost of substation switching equipment.
  4. Cost of generating station transformers.
  5. Cost of substation transformers.
  6. Cost of transmission cables or lines.
  7. Distance of transmission.
  8. Cost of transmission cables or lines as outlined in I.
- B. Size of transmission conductors:
  1. Number of circuits required per substation.
  2. Size of substations.
  3. Layout of substations.
  4. Economic balance of fixed charges and losses.
  5. Rating of cables due to heating or of lines due to regulation.

III—Substation
- A. Types of load fed:
  1. All distribution.
  2. Industrial loads at higher than distribution voltage.
  3. Use of interstation ties.
- B. Transmission system:
  1. Voltage of transmission.
  2. Capacity of transmission cables or lines.
- C. Economies of transformer sizes:
  1. Size of substation.
  2. Ratio of transformers:
     (a) Economic transmission voltage.
     (b) Economic distribution voltage.
  3. Type of transformers:
     (a) Single phase.
     (b) Three phase.
     (c) Auto.
- D. Use of high-tension bus structures:
  1. Matching of capacity of transmission circuits and transformer banks.
  2. Operating flexibilities required.
  3. Cost of iron losses in transformers.
  4. Cost of high-tension bus structure.
- E. Low tension bus structure and regulators:
  1. Distribution voltage.
  2. Amount of regulation required.
  3. Capacity of distribution cables or lines.
- F. Size of substations:
  1. Load density in distribution system.
  2. Capacity of distribution cables or lines.
  3. Economical length of distribution feeders.

IV—Distribution System
- A. Voltage of distribution:
  1. Load density.
  2. Type of system.
  3. Economic balance between cost of cable or lines and line losses.
  4. Cost of distribution transformers.
  5. Cost of miscellaneous equipment on distribution system.
- B. Layout of distribution system:
  1. Load density.
  2. Local geography.
  3. Reliability requirements.
  4. Flexibility required for operation and maintenance.

pacity for the distribution cables. There is one other requirement, of real practical importance, which although not entering into the economical feature, should not be lost sight of, that is, the regulation. Often the economical voltage drops will be in excess of the permissible drop.

The outline in Table 1 shows, in general, the features entering into the design of an electric system and particularly their interrelation; that is, the dependence of the design of one part of the system upon the economic layout of another part. Thus, in conducting the general study of system design, the problem cannot be solved without considering all of its ramifications and the effect of the design of one feature upon other parts of the system. The outline in Table I is not intended to be entirely comprehensive, but rather illustrative of the general features of the problem and as an example of the factors involved.

In the following paragraphs a suggested method is outlined for conducting a general study for determining the economical size of a substation which will result in the most economical electric system. The most general method has been outlined where it would be possible to rebuild the entire electric system if this proved to be economical. However, it must be remembered that frequently we have existing systems which cannot be changed. Transmission and distribution voltages may have been standardized to the extent where it would have been impracticable to change them. In such cases the study would not be quite so general, but would assume certain transmission distribution voltages and possibly even certain definite size and capacity of transmission and distribution cables.

Before the study is made the existing load densities should be investigated and the possible growth and probable ultimate load densities should be studied. The next step would be to lay down certain fundamental practices such as the permissible variation in customers' voltage and to what degree should reliability of service be stressed. The first step in conducting a study of this kind will be to assume one or two transmission voltages and likewise, if feasible, one or more distribution voltages. Then a number of substation sizes could be determined, varying, say, from 3,000 to 40,000 kva. For each size of substation and for each transmission and distribution voltage a substation should be designed which would represent the minimum cost for that size and design consistent with reliability. In laying out such a substation care should be taken to consider not only economy of design but possibility for future expansion with minimum cost as the load densities increase and justify larger substations. Estimates of the cost of each substation so designed should be prepared and a series of curves may then be plotted for each transmission and distribution voltage of substation cost against substation size. In estimating these costs operating labor as well as losses should be included.

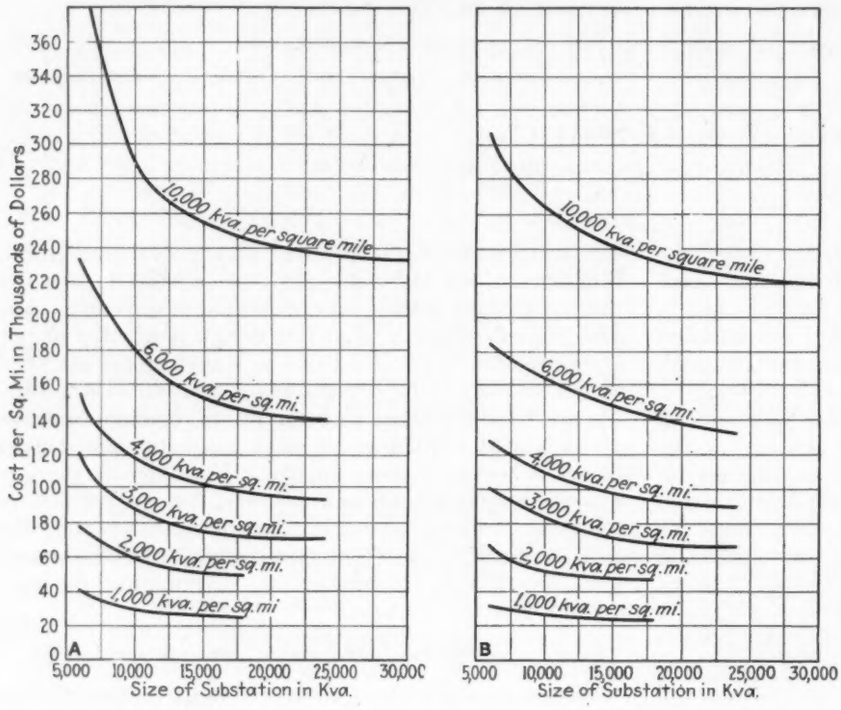
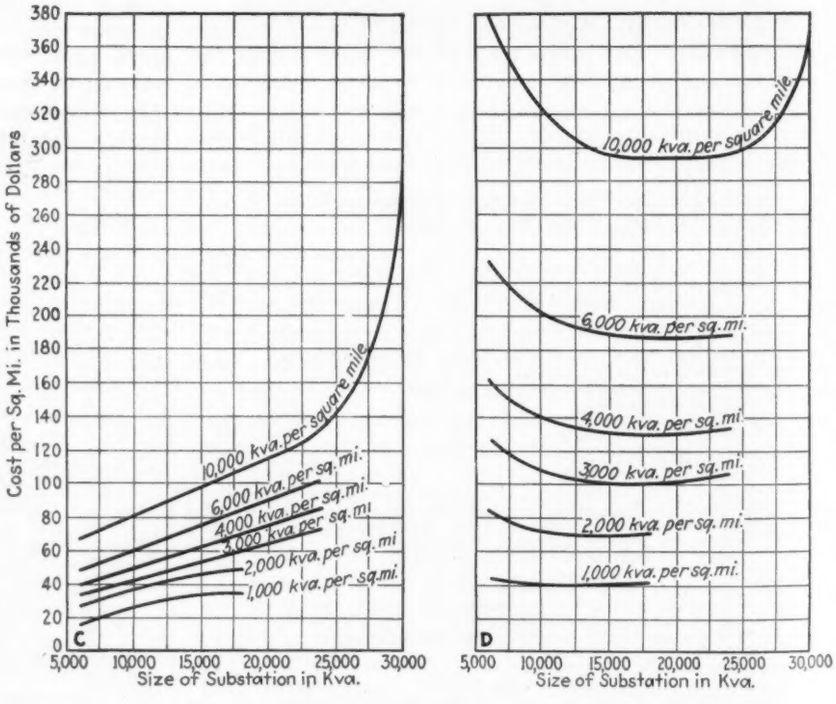

Cost per Sq. Mi. in Thousands of Dollars
10,000 kva. per square mile
6,000 kva. per sq. mi.
4,000 kva. per sq. mi.
3,000 kva. per sq. mi.
2,000 kva. per sq. mi.
1,000 kva. per sq. mi
A
B
Size of Substation in Kva.

Fig. 1 (A)—Variation in substation cost with substation size at various load densities. (B) Cost of transmission at various load densities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6,000 kva. per sq. mi.
4,000 kva. per sq. mi.
3,000 kva. per sq. mi.
2,000 kva. per sq. mi.
1,000 kva. per sq. mi.
C
D
Size of Substation in Kva.

Fig. 2 (C)—Cost of distribution feeders at various load densities. (D) Total cost relating to economic design with substation size at various load densities

The second step would be to determine transmission costs. In determining transmission costs, not only the location and length of cable from existing generating stations should be considered, but the same information should be estimated for future generating station sites. For each substation size there will be probably an economical voltage of transmission as well as size and capacity of cable. The first step in determining the transmission costs then would be to determine the economic voltage, the economic size and capacity of cables for various sizes of substations for each voltage of transmission assumed. This information could be plotted in the form of curves having a curve for each transmission voltage and would be total transmission costs for each substation plotted as a function of the substation capacity. These costs should include the cost of cable installed, the cost of the duct system, and the cost of the losses capitalized. If the generating stations are fairly close to the load so that the relative locations of the substations affect the transmission costs, a set of curves will have to be derived for each load density.

The third item entering into the total cost is the cost of the distribution system, which cost, however, would include only the cost of the distribution cable to the feeder points. These costs depend upon the substation size and load density and the reserve capacity provided. For any given load density and substation size there is an economical size and capacity for the distribution feeder. This should be determined for each load density and substation capacity. When this has been done and the costs determined for each substation size and load density a series of curves should be plotted with the distribution cable cost as a function of the substation size. These costs should include the cost of the cable, the cost of the duct system and the cost of losses capitalized.

From the data determined as above it will be possible to plot a series of curves having a curve for each load density of total cost plotted as a function of the size of the substation. Several sets of these curves may be required. If several transmission and distribution voltages are considered from these curves, the most economical arrangement can be determined for any load density. The next step is to consider the growth of load density and the size of substation that would be economical at these various load densities. From this information it would be possible to develop a well-organized plan for extensions and limiting capacities of the various substations.

Sample Studies

A sample study has been prepared along these lines following the method outlined above. However, the study has not been made quite so general as the study outlined above, in that 13,200-volt transmission and 4,150-volt distribution have been assumed. These costs must be assumed to be estimated costs only and should be considered as illustrative of the method only and not as a basis for drawing any definite conclusions

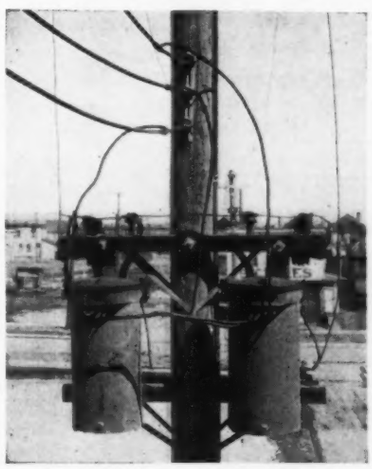
In the sample study, which is somewhat academic in its nature, the transmission costs include only cable costs within the area considered; that is, the entire transmission cable cost from the generating to the substations has not been considered. Usually, the generating station is located outside of the urban area fed by the substations; therefore, if the size and voltage of the transmission cables is restricted the transmission costs from the generating station to the beginning of the urban district which includes the distribution system, will be practically the same for various sizes and locations of substances, varying only for that part of the transmission cables included within the area under consideration. In a more general study, the entire cable costs should be considered as well as the generating station switching costs in that the capacity of the individual transmission cables influences the generating station switching costs by virtue of the fact that the smaller the capacity the greater number of cables required.

A set of curves prepared for substation costs for various sizes of substations is shown in Fig. 1A. For convenience these curves have been plotted as cost per square mile for various load densities. Fig. 1B shows the costs of the transmission at various load densities and for various substation sizes. For convenience the costs have been determined in cost per square mile. Fig. 1C shows curves plotted in a similar manner for the cost of the distribution feeders.

The next step in this study is to combine these figures. Fig. 2D shows the total curves for each of the various load densities when plotted as a function of the substation size. From this series of curves the economical size of substations for various load densities can be readily determined. From the curves in Fig. 2D it can be seen that in most cases the economical size of substation can be made to vary over a reasonably wide range, in that the curves are fairly flat at and near the minimum points. Representative substation practices are tabulated in the supplementary insert accompanying this issue of the Electrical World.

Series-Parallel Transformers for Heavy Residential Loads

By T. A. Robinson
Distribution Department,
City of Winnipeg (Canada) Hydro-Electric System



Two 25-kva., 2,400-240/120-volt transformers connected series-parallel for heavy duty

In Winnipeg, Canada, where the residential load per block may exceed 50 kw., it is quite common practice to hang two transformers side by side on the same pole. The primaries are connected in parallel and the secondaries in series. Each transformer secondary supplies 120 volts and the common point is grounded. They are connected to the 240/120-volt secondaries and are sometimes in parallel through secondary sectionalizing fuses with other transformers so connected.

There are many arguments for and against using transformers with this connection, the main point in favor being the fact that, if a short circuit occurs on one side of the secondary, only one transformer goes out, leaving the other still carrying its part of the load and giving light to the district. Some of the points against it are:

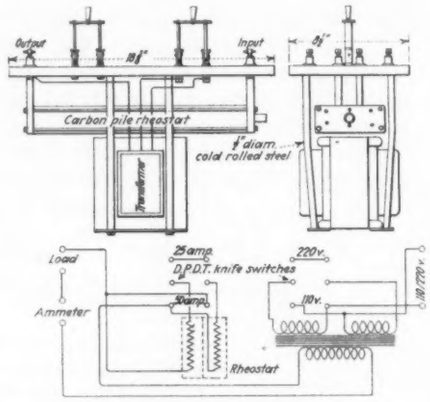
Higher initial cost, maintenance cost, etc., and higher operating costs; the regulation also is not so good as if one transformer of double capacity were installed. However, where the residential load density may amount to 5 or 10 kw. per pole the average transformer size is 25 kva. and these considerations lose in importance because the relative loss in efficiency between two 15- or 25-kva., two-wire transformers compared to one 30- or 50-kva., three-wire transformer is not so great as between smaller wires.

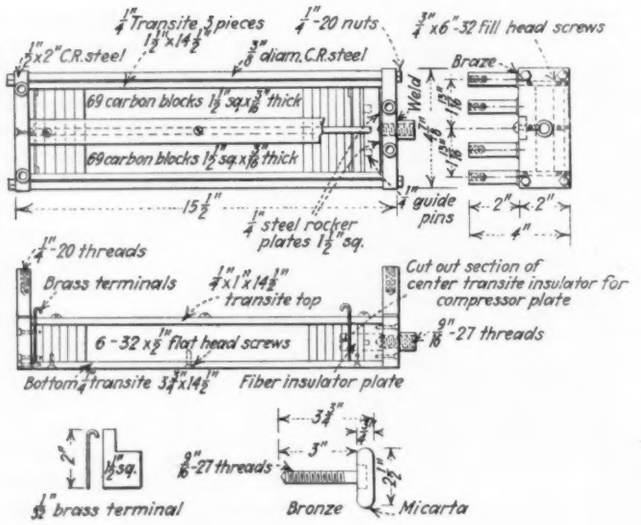
Large Capacity Load Box

By Fred Habel
Detroit Edison Company, Detroit, Mich.

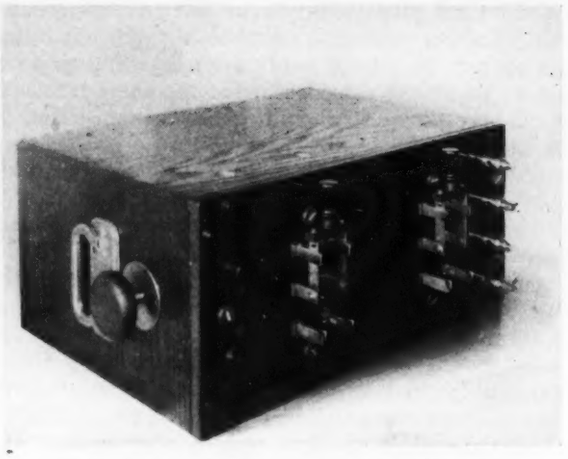
THERE are frequent requirements in the testing of relays and meters that demand currents heavier than are supplied by the usual types of artificial loads. To meet this demand on the Detroit Edison system there has been developed and constructed the load box illustrated.

Arrangement of parts and wiring diagram of load box





Two ranges of current with maxima of 25 and 50 amp. are available and the supply energy may be taken at 110 or 220 volts as desired. The transformer in the box has a double primary, the series or parallel connection of which provides for the two impressed voltages. The secondary of the transformer is rated at 56 volts. The current output is controlled with a compression carbon rheostat arranged so that its two longitudinal halves may be connected in series or parallel for the two current ranges. For adjustment the handle has a fine thread so that a fine adjustment of current is had. The principal features of this load box are flexibility of application and ease and accuracy of test current control.



Exterior of large capacity load box

Reflection Factors of Porcelain Enamel and Various Metals

By M. Luckiesh
Director Lighting Research Laboratory, National Lamp Works of General Electric Company, Cleveland

IN THE design and use of light-reflecting equipment several characteristics of the reflecting surface are of importance. Three of these are (a) the reflection factor of the surface, (b) the maintenance of the reflection factor, (c) the control of the reflected light. Experience has given sufficient information regarding (b) and (c), but available data regarding reflection factors are somewhat meager.

During recent years measurements of diffuse reflection factors of many materials have been made at Nela Park for the purpose of determining their suitability for use in reflectors. In all cases the surfaces were clean, and most of them had been polished or otherwise prepared by those submitting them, with the object of utilizing them for light-reflecting devices. A summary of some of the measurements of reflection factor for diffused light is given in the table.

MEASUREMENTS OF REFLECTION FACTOR FOR DIFFUSED LIGHT

Materia	Number of Specimens	Reflection Factor, Per Cent Range	Average
Porcelain enameled metal	5	72 to 77	74
Aluminum sheets	60	55 to 84	68
Cadmium-plated metal	5	50 to 74	64
Chromium-plated metal	7	60 to 66	62.5
Monel metal	1	.....	49
Nickel-plated metal	4	61 to 65	63.5
Nickeloid*	7	59 to 78	71
Silver-plated metal	2	90 to 91	90.5
Silvered glass mirror	1	.....	93

*American Nickeloid Company.

In the case of plated metals it is quite evident that the reflection factor may be affected by the thickness of the plated coat. We also find large differences between individual specimens of aluminum prepared in different ways. Part of the difference may be due to impurities, but some of it is evidently due to the method of preparing the surface.

The Utility's
Responsibility in Refrigeration*

What the central station companies can do to help stabilize and stimulate electric refrigeration sales to make the business more profitable

By R. W. CURRAN
General Manager Bartlesville Gas & Electric Company, Bartlesville, Oklahoma

DURING the past three years we have witnessed a remarkable but erratic development of the electric refrigeration industry. Prior to 1926 the development of domestic electric refrigeration had been slow and had met with indifferent success in practical application. But 1926 saw a tremendous expansion in the industry, which resulted in a demand far exceeding the manufacturing capacity. To meet the ever-increasing demand manufacturers were thrown into forced production, thus adding to the confused conditions already created by slipshod sales, installation and service methods. In 1927, however, these conditions were reversed and we saw sales of electric refrigeration units gradually overtaken and passed by manufacturing capacity until warehousing had absorbed a very great amount of working capital of the manufacturers and the business was generally in the "dumps."

Naturally, the electric utility industry was exposed to these ups and downs of refrigeration development and was quite appreciably affected financially as a result, and many of us in the utility business have seen our hopes and expectations of 1926 gradually "peter out." These experiences of the last two years have engendered doubts in the minds of many of us and we are inclined to adopt a wary and cautious attitude toward the refrigeration industry. However, facts do not warrant such pessimism. It should be remembered that electric refrigeration must experience its growing pains, like other successful businesses, during the stages of development. What the business now needs more than anything else is a stabilizing influence that will guide it into its proper stride as quickly as possible, and that stabilizing influence is the sponsorship that the utility industry can and should assume over the expansion of electric refrigeration. The utility is more needed now than at any time in the past.

That the safe and sane development of electric refrigeration is of outstanding importance to the electric utility industry is generally conceded. It seems, therefore, that from a selfish standpoint only it behooves us to lend every practical aid possible in promoting electric refrigeration along sound lines to the end that we realize the benefits that will accrue from such a policy as soon as possible.

The problem before utility men is that of how best to apply their co-operation to obtain the most satisfactory results from the standpoint of both the utility and the refrigeration industries. This problem primarily involves selling, installing and servicing electric refrigeration; it consists of two phases, one involving a solution in those communities having approximately 5,000 or less domestic electric customers and the other applying to communities having more than this number of domestic consumers.

"ORPHANS ARE DETRIMENTAL

The smaller cities and towns present a very restricted market. An electric refrigerator placed in a home replaces a necessity and, in turn, its continuous and satisfactory operation becomes a necessity. The selling and installation of electric refrigeration, if done properly, is one clearly defined step in the promotion of the business, but the responsibility for seeing that it operates continuously and satisfactorily is present year in and year out, and that responsibility must be fixed and definite. If too many manufacturers are represented in such a restricted market the business will surely be unprofitable to some of them in a short time, and presently one or more will pull out and leave their orphans to shift for themselves, with the consequence that lack of service places the whole business in ill repute before the public generally. Such an experience results more disastrously to the local electric utility than to the manufacturer who moves out as soon as he realizes that he is just one too many in the market.

To prevent such an experience, the local electric utility is in position to promote electric refrigeration in its community by either handling the sales, installations and servicing of one or more makes of equipment itself to the exclusion of all other dealers or to co-operate with the proper number of dealers for the same end. In either case, the problem is squarely up to the utility if it is to benefit in the expansion of the refrigeration business.

In the larger cities the market is so much broader that market conditions will attract a large number of dealers with the possibility of profit to all of them intelligently handling reliable equipment. The problem is one of organization of all interests for the sound promotion of the refrigeration business. Obviously, the utility is again in the position of the one interest to be the most advantageously or adversely affected. Therefore, it is automatically placed in position to render the most effective leadership or sponsorship in seeing that the business is organized and carried on along the soundest lines. Many utilities have not seen fit to enter the field of electric

**Abstract of a paper read before the tenth annual convention of the Oklahoma Utilities Association held at Tulsa, Okla., March, 1928.*

refrigeration very actively themselves in the larger communities, but it seems that the success of the whole business is so largely dependent upon the policy of the utilities that for the efficient exploitation of this field they should be active promoters themselves, if for no other reason than to keep in step with every development, thus enabling them to exercise most intelligently their privileges as sponsors.

The utilities' experiences of the past few years lead to some suggestions for improvement in the methods employed by the manufacturers and dealers. The Bartlesville Gas & Electric Company has pushed domestic electric refrigeration consistently and intensively for two years. During that period about 7 per cent of the domestic customers of that company have purchased this type of refrigeration. This company was fairly besieged by nearly all the refrigerator manufacturers to handle their equipment, but the lines were confined to those of two manufacturers. Liberal terms were granted and free service for one year guaranteed, with indefinite service at actual cost after the first year. The first year the regular lighting rate was effective and sales were very satisfactory. During the second year a special refrigeration rate was in effect and sales were again very satisfactory, but it was noted that the prospects had become much more discriminating, which necessitated more intense sales effort to reach the desired volume.

A Desirable Load

The results of these two years of activity of that company have been fairly well analyzed, and the most pertinent items thus deduced are:

1. The average yearly consumption for domestic refrigeration is 700 kw.-hr.
2. The customer is eminently satisfied with mechanical refrigeration both regarding service and operating costs.
3. The cost of servicing for the two years was far above the figure anticipated.

Commenting on these results, the 700 kw.-hr. per year per customer was added to the domestic energy sales without the spending of any money for increased distribution, service or meter capacities. The percentage of refrigeration saturation is only 7 per cent, but it is expected that costs of increased distribution capacity will be only nominal at any saturation greater than this. This illustrates, to some extent at least, the very desirable character of this load and why a lower rate may be justified, provided service expense is nominal.

From the customer's standpoint it was found that practically every housewife derives more pleasure and pride from the possession of an electric refrigerator than from any other piece of furniture or household appliance. Day and night service was rendered and the equipment was made to operate as it was represented it would operate. However, the cost of servicing was found to be very much greater than anticipated, even considering that the company was doing pioneer work in that it was promoting a new appliance in a new field. The two years' experience of the utility mentioned has been, therefore, highly encouraging with the one exception of service costs.

Since this matter of excessive cost of servicing has been the one large drawback to promoting electric refrigeration, it might be well to study this feature in a critical way and assign reasons for it and propose what one utility company, at least, thinks is a solution to the problem.

The chaotic conditions of 1926 and the consequences are well known. In 1927 the business went into the dumps and the manufacturer who had his working capital tied up in stocks and new factories was financially unable to push his development work to the extent that he would have had his finances allowed. For the same reasons, servicing of units in operation was below normal, and those utilities which had committed themselves to the responsibility of maintaining service were hard put both physically and financially in some cases to make good to their customers. Clearly, they had no other choice if they faced the facts and had faith enough in the future to see the whole show through. The manufacturers did, in most cases, stand back of their guarantee to replace defective equipment, but it is evident that the central station that played the game bore the brunt of the work in keeping electric refrigeration in popular favor during the past two hectic years.

The manufacturers have maintained relatively high list prices and relatively low discounts, and properly so until they recoup past losses and perfect their equipment. On the other hand, the central-station companies have sacrificed all merchandising profits and even entailed large expense in order to keep electric refrigeration on the map and in a position to expand.

Further Development

In view of this situation, it behooves utility men to insist that the development and perfection of the mechanical refrigerator be carried out at the earliest possible moment, and the manufacturer who indicates that he regards the perfection of his machine his paramount concern should certainly receive the greatest consideration of the electric utility industry. There are electric refrigerators in operation that have given entire satisfaction, with only nominal service coses, for seven or eight years, and surely after the experiences of the last few years the manufacturers can appreciate the value of development and we are warranted in expecting a radical improvement all along the line in 1928 and the years to follow.

Servicing by the Central Station

The utilities themselves should lead the way in perfecting methods of efficient and inexpensive servicing. Proper sales methods, intelligent application and installation of electric refrigeration, in the first place, will eliminate much of the servicing that has been experienced in the past. Then, with better equipment to sell and the perfecting of service methods, the matter of servicing should eventually be a matter of nominal proportions. Some dealers and utility executives are already advocating that all servicing of electric refrigeration equipment in a given community be handled by one organization, preferably the utility. This scheme involves the training of experts to do the service work and looks to be the logical procedure. Many utilities would find it much easier to train their employees for this work than any other organization and no doubt would be in better position to maintain service crews the year round.

In conclusion, it seems that the success of electric refrigeration business for domestic use is checked squarely up to the electric utility industry. If it is to expand along sound lines the central-station companies must get the local selling, installation and servicing of mechanical refrigeration properly organized and support and guide it with our organizations. With close co-operation with those manufacturers who appreciate the present difficulties in the business and are making sincere efforts to overcome them, 1928 should be the beginning of a new era of expansion in mechanical refrigeration.

Enameling Refrigerator Parts *Electrically*

Data on energy consumption of ovens treating evaporator units and box linings. Uniform operating cycles obtained

By A. N. Otis
General Electric Company, Schenectady, N. Y.

A NUMBER of electric furnaces of modern design are used in General Electric factories for vitreous enameling of parts for domestic refrigerators. These furnaces are equipped with power-operated doors and charging forks and the nature of the work involves a fairly wide variety of parts. These include the evaporator unit, which is relatively heavy; the top frames, legs and door linings, which are relatively light, and the box linings, which are relatively large in proportion to their weight.

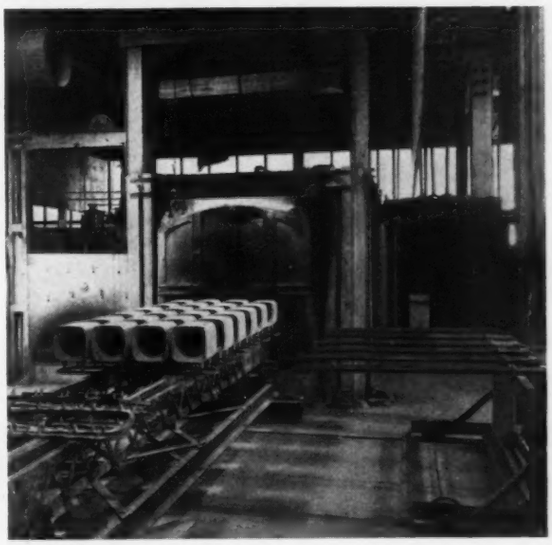
All these furnaces are equipped with heating units in the roof and floor and have grid hearth plates, which are designed to catch any pieces that may fall off the racks. The grid construction offers little resistance to heat flow from the bottom units to the material in process.

Tests have been run on two of these furnaces to obtain the economy of operation and these are presented as typical for electric furnaces in this class of work.

These furnaces are 4 ft. wide, 10 ft. long and 2 ft. high. Each has a connected load of 170 kw. at 220 volts, three phase. The heaters are divided by two control circuits, one for the body of the furnace and the other for the front section.

TABLE I—OVEN PERFORMANCE IN ENAMELING EVAPORATOR UNITS

Weight of evaporator unit, lb.	23
Number per load	18
Weight of pin bar, lb.	20.5
Number per load	6
Working hours	129
Number of heats	400
Average heats per hour	3.1
Number of evaporators burned (one burning)	7,197
Number of pin bars heated	2,400
Total power consumption, excluding Monday a.m. preliminary heating, kw.-hr.	18,040
Weight of evaporators heated, lb.	165,531
Weight of pin bars heated, lb.	49,200
Total weight heated, lb.	214,731
Pounds per kilowatt-hour gross, lb.	11.9
Pounds per kilowatt-hour net, lb.	9.17
Time required to reach operating temperature Monday a.m. after 37 hours shut-down, minutes	65
Time allowed for heating and soaking Monday a.m., hours	2
Energy required for heating and soaking as above, kw.-hr.	265
Radiation loss, 875 deg. C., furnace only per hour, kw.-hr.	26



Furnace for enameling evaporator units

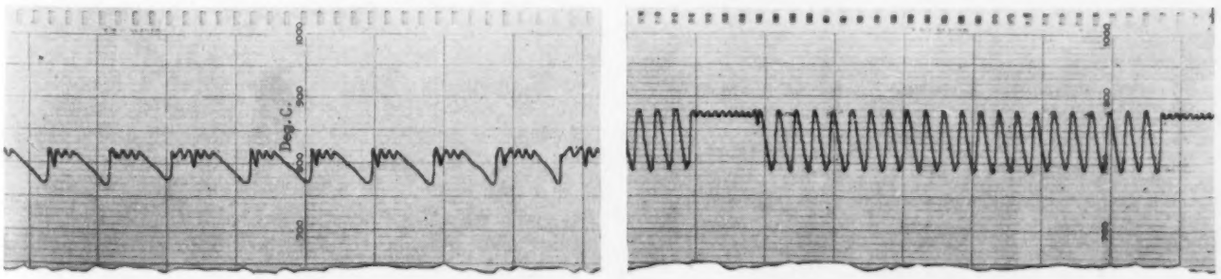
Each evaporator unit is made of three deep-drawn shells nested together, and all the external surface is enameled, including both inside and outside, making it necessary to heat the inner shell to enameling temperature.

The parts are supported on pin bars, there being six bars to a load, each holding three evaporators, or eighteen to a load. The normal schedule for firing is three loads per hour, this relatively long time being allowed to heat the inner shell. The ground coats are fired at 875 deg. C. and the finish coats at 820 deg. C.

Each furnace has a preheating oven of the same chamber dimensions as the furnace itself. This oven has a connected load of 75 kw. and is maintained at 370 deg. C. The furnace, oven and loaded fork are shown in an accompanying illustration.

A record of one of these furnaces was kept for a week, the results of which have been summarized and appear in Table I.

The evaporator units are dried in a steam-heated oven and are warm when they enter the preheat oven. The pin bars also are warm from the previous run when they enter the preheat oven. However, the test shows the

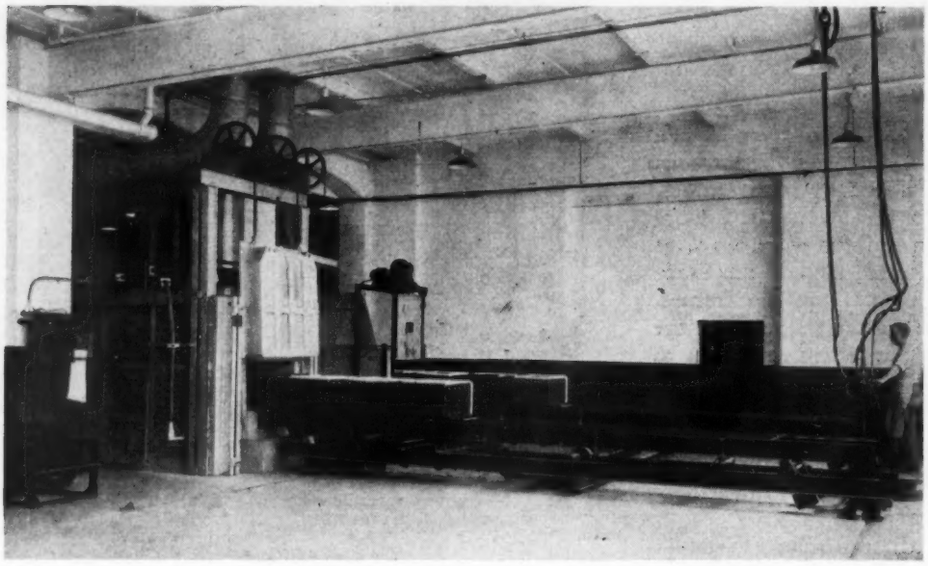


Temperature records for enameling evaporator units and box linings

economy that can be expected under the conditions of operation stated.

A typical chart from the temperature recording instrument is shown. Each chart division represents an interval of twenty minutes. Energy input was measured on the primary side of the transformer which serves the furnace, and the readings therefore include the transformer losses, giving the total energy consumed by the installation.

The furnaces for enameling box linings are 4 ft. wide by 12 ft. long and each has a connected load of 260 kw. They are, therefore, the same width as the furnaces previously described, but they are 2 ft. longer and have considerably more kilowatt capacity, as they are designed for more frequent opening of the doors. One of the furnaces with its steam-heated drying oven is shown with its double charging fork and travel carriage for handling the work.



Furnace for enameling box linings

In operation a group of four linings is brought into the drying oven at the rear on an intermittent conveyor. After the specified period, one of the forks is run in to pick them up and at the same time the other fork picks up a similar group in the furnace. Both forks are withdrawn, the carriage run down the room and the forks are advanced. This places the dried parts in the furnace and the burned parts on the conveyor in the foreground, which carries them back to the spray booths for the next coat or to storage if finished.

TABLE II—OVEN PERFORMANCE IN ENAMELING BOX LININGS

Weight of lining, lb.	40
Number per load	4
Loads per hour	9 to 12
Working hours	144
Number of linings burned (one burning)	5,404
Total energy consumption, excluding heating up Sunday night, kw.-hr.	26,557
Weight of linings heated, lb.	216,160
Pounds per kilowatt-hour, lb.	8.15
Temperature at 10 p.m. Sunday after cooling 22 hours from 860 deg. C., deg. C.	630
Time to restore temperature, minutes	45
Time allowed for heating and soaking before starting, hours	2
Energy required for preheating, kw.-hr.	290
Radiation loss at 830 deg. C. per hour, kw.-hr.	20.8
Area enameled 5,404x16, sq.ft.	86,464
Area enameled per kilowatt-hour, single coat, sq.ft.	3.25

The linings contain approximately 16 sq.ft. of sheet steel and weigh 40 lb. each. Four are loaded at a time. The pin bars remain permanently in the furnace. The ground coats are fired at 860 deg. C. and the white coats at 830 deg. C. The average production is ten loads per hour, but sometimes twelve loads are obtained. The doors, forks and carriage are all operated by one man from the central control position shown.

The temperature of the drying oven is about 100 deg. C. and the parts are, therefore, warm, approximately 60 to 70 deg. C., when they enter the furnace.

These furnaces are operated continuously on three shifts, being shut down only from midnight Saturday to midnight Sunday. Records were kept for a week's run, the results of which are summarized in Table II.

The frequent opening of the door, necessary with sheet steel enameling, is a major source of heat loss. This loss depends to a considerable extent upon the skill which the operator acquires in manipulating the forks and doors. Many operators do not realize the extent to which this item contributes to the over-all economy of the furnace.

A section of the temperature record shows a steady rate of charging and a period of interruption due to lack of parts or some other cause. It will be noted that the temperature just reaches normal for each charge before the next one is put in. Observation shows that sometimes the control will throw off just before the parts are removed and sometimes it will not, indicating that the furnace is operated nearly at its full capacity.

It is believed that these tests well represent the economies that may be anticipated with modern furnaces in continuous operation.

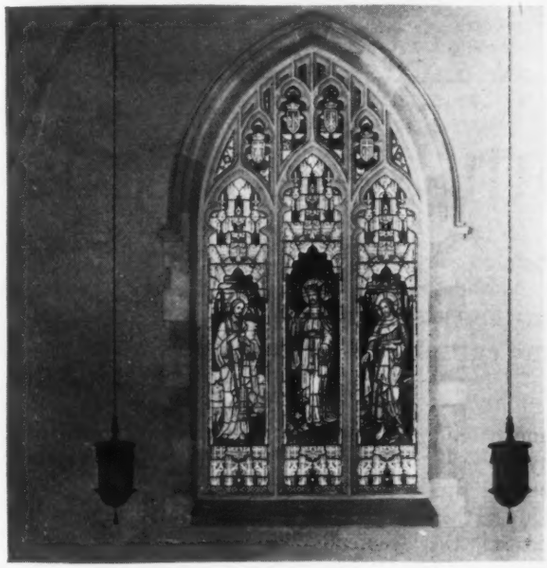
Utilities Co-operate to Reduce Street Congestion

PUBLIC utilities operating in the city of Oakland, Calif., in an effort to assist in reducing street obstructions to a minimum have voluntarily established a clearing house through which each utility notifies a secretary of its intention to work at a certain location on a certain day so that two utilities shall not work near the same location at the same time. When starting work at any location the traffic officer is notified and every assistance is given him in speeding up traffic by careful placing of carts, removing carts from main streets at noon, working continuously after a job is once started, parking compressors at the curb and running hose, closing streets over Saturday and Sunday, etc.

In this way the utilities feel they are doing their part in reducing street obstructions and forestalling the day when they may be required to do all construction work at night, as is now required in many large cities where traffic conditions are highly congested.

Indirect Lighting of Church Window

By Willard Allphin
Lighting Engineer Fall River (Mass.) Electric Light Company



Window illuminated from rear

IN THE Union M. E. Church at Fall River an unusual lighting problem was presented by a stained glass chancel window backed by a second floor hallway instead of being set into an outside wall. The use of artificial light in the daytime was essential because of this condition. The window was originally illuminated by a reflector of the show window type in the hall ceiling and a floodlight on the hall floor. This was unsatisfactory as the ceiling reflector was visible only as a bright spot and the floodlight caused shadows of those who passed between it and the window to be visible in the church.

To solve the problem, a partition was constructed behind the window and 50-watt mill-type lamps in silvered glass reflectors were used to illuminate the rear wall of the partition. Twenty-four reflectors were used, one row at either side of the window and one at each vertical rib. It was considered advisable to use four rows rather than two because the depth of the box was limited by the position of the stairway.

The window is 7½ ft. wide, 14 ft. high and the partition is 20 in. deep. It is finished on the inside with flat white paint and on the outside to match the finish of the hallway.

Electric Melting of Lead Making Rapid Headway*

ELECTRIC melting has made marked advances of late in manufacturing processes involving the use of lead. Lead is extensively used in the making of storage-battery plates, scale weights, lead-covered cable, heat-treating of metal parts and other work. The plant of the Willard Storage Battery Company at Cleveland has a connected industrial electric heating load of 200 kw., with complete electrification of processes. Labor costs have been reduced to a minimum here. Another manufacturer, the Federal Battery Company, Brooklyn, N. Y., is also a consistent user of electric heating.

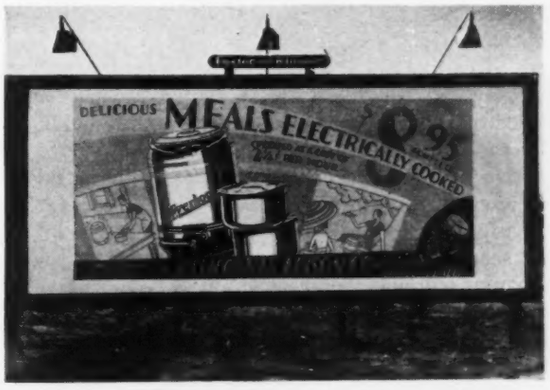
At St. Johnsbury, Vt., the Fairbanks Scale Company uses lead melting pots, each of 2.5 kw. rating and a melting capacity of 100 lb. per hour. The General Electric Company is a large user of the electric lead pot in cable manufacture. The molten lead is applied to the cable at a temperature of 750 deg. F., the weight of the lead sheath varying from 1 lb. to 4 lb. per linear foot, depending on the size of the cable. One pot in use has a capacity of 2,000 lb. per hour, which means that about 1,000 ft. of cable per hour is obtained with an energy consumption of 50 kw. The United States Rubber Company uses lead pots of from 2 to 5 tons capacity in making hard rubber. These are rated at 30 kw. each, having cast-in immersion heating elements. The melting rate of these pots is about 1,000 lb. of lead per hour at 750 deg. F.

*Excerpt from James H. McGraw first prize paper, N.E.L.A. competition, 1928, B. M. Riker, author.

Employees "Put Over" Cooker Sale

AT THE end of seven weeks of a sales campaign scheduled to continue throughout the summer more than 2,200 "Everhot" cookers were disposed of by the Southern California Edison Company. These cookers were sold at $8.95 cash or $2.20 down and $2.50 per month for three months. While every effort was made by the regular sales force to further the campaign, the means of actually carrying the message to the public rested upon the non-selling employee group. Employees were given a commission of $1 for every sale, and each district organization set individual sales quotas which tended to arouse interest among the amateur salespeople.

As an additional inducement to increase sales by employees a bonus of $1 was given to those selling ten cooker pots. This bonus proved very effective and was in addition to the regular dollar commission paid for every sale. No premiums of any kind were used, and the entire sales argument was made upon the basis of a bargain price. For the first time in its merchandising history the Edison company resorted to billboards to help put over a sales idea. Thirty-one boards in ten districts were used during the month of July. The cooker and the price of $8.95 were featured in the billboard advertising. The signature of the Southern California Edison Company was followed by the phrase "or your dealer." A six-page stuffer attractively laid out was sent out with



One of the thirty-one billboard displays used by power company in cooker-pot campaign

electric bills to more than 250,000 residence consumers.

Uniform window displays in district offices were made possible by sending out a photograph of a sample window together with the necessary window trim.

In an attempt to have the campaign reach women's clubs, church organizations, boy scouts and other such organizations, a plan was instituted which provided that these societies could sell a certificate which the Edison company had prepared to their own members for one dollar. This certificate entitled the member to buy a cooker at one dollar less than the selling price, which put a dollar in the treasury of the organization and at the same time helped spread the sale of cookers. No employee commission was paid on this type of sale.

Financing Without a Mortgage

One large utility system, Associated Gas & Electric Company, provides all its capital requirements through the holding company entirely

ANALYSIS of recent financing operations by power and light companies discloses an interesting departure from the policy recognized and adopted by the great majority of the industry. The largest single piece of financing this year so far, the recently offered $65,000,000 debenture issue of the Associated Gas & Electric Company, and an issue similar in nature and amount previously sold by the same company, illustrates this divergence from what has become almost unanimous practice. The difference in policy involved has to do with the method of securing new capital.

Following a policy similar to that adopted by the American Telephone & Telegraph Company, the Associated Gas & Electric system raises its new capital on the security of the entire system rather than on specific property. Since it is the first of the major power and light groups to adopt this type of financing, its policy is of interest to the industry as a whole.

Although capitalization of the industry today stands at some figure only slightly under $10,000,000,000, the power and light companies require a huge addition to this amount annually. This addition last year exceeded $2,000,000,000. In an attempt to attract an adequate share of capital for its needs the early executives of the industry chanced upon or worked out varying financial policies and methods. Gradually the holding company assumed a dominant position in a large portion of the industry, and the raising of equity capital came to be looked upon as a holding company function.

In securing new capital most of the power and light companies have, in the past, adopted the policy of raising senior capital by placing a mortgage upon individual properties and raising probably 60 per cent of their requirements in this way. The balance, or junior capital, is divided usually on something like a 30-20 basis between preferred and common stock. The policy represented by Associated Gas & Electric financing, however, differs radically. This company is now providing the senior and junior requirements of its entire system through the holding company almost entirely and the subsidiaries have become virtually non-existent, financially. For the most part all securities existing in connection with subsidiary companies are being gradually acquired or retired by the holding company, especially issues whose interest or dividend charges are higher than those current. A financial holding company, the Associated Electric Company, was launched as a vehicle by which the new financing was carried out.

Under the more usual policy of financing, as already indicated, the greater portion of the power and light industry secures its capital for additions and extensions, or for the purchase of new property, by the issue of obligations directly by the operating company. The ordinary procedure in such cases is for the operating company to raise the necessary funds on its own security and through its own channels. The holding company, of course, may undertake the actual details of the sale of the issue. Subsidiary capital structures may be left very much intact, or may be greatly simplified according to the needs of the group. In the case of the holding company financing, equity operations are carried out at or near the top of the organization. They are based on the security or credit of the entire group of companies. With the majority of the industry, senior financing is carried out at the base of the holding company group and is secured by actual property mortgage. In the former case the holding company obligations are not specifically secured. The policy is best illustrated by a glance at the Associated Gas & Electric's financing policy.

The first step, as already indicated, was the organization of a subsidiary, the Associated Electric Company, to carry out all financing operations. This organization is controlled by the Associated Gas & Electric Company and in turn controls a group of public utility properties in various parts of the country. The new company was designed to "provide a sound and permanent medium for major operations in financing and developing the entire system." Most of the proceeds of the $65,000,000 issue referred to were used to retire various high-rate securities, effecting a substantial saving in the aggregate annual interest, dividend and sinking fund charges.

Since there is neither an underlying mortgage nor a sinking fund in connection with the new issue, some question as to security and further issue naturally arises.

The sponsors of the issue went much further than usual in tightening the restrictions upon subsidiary financing. There are rigid maintenance and replacement provisions, and through such precautions, according to advocates of this policy, a firm foundation is established for future financing. Additional bonds may be isued only for refunding or construction purposes or for purchase of new property under the usual 75 per cent limitation. These may be issued to a total not exceeding $1,500,000 for the acquisition of outstanding minority interest of certain subsidiaries. A rather unusual provision under the indenture is that additional securities of subsidiary companies may not be sold except to the company or to another subsidiary, if the total amount of such securities held by the public would thereby be increased to an amount exceeding 50 per cent of the bonds then outstanding under the indenture. This includes as outstanding any of the bonds issued under the indenture and converted into a security junior thereto. For maintenance and replacement, the indenture requires that subsidiary companies shall set aside from each year's operations an allowance equal to 12½ per cent of the consolidated gross operating revenue from electric operations, 10 per cent from gas operations, 5 per cent from water and 25 per cent from traction operations.

Diversification Feature Stressed

Advocates of the type of financing just outlined maintain that the security behind the outstanding issue is greater in view of its diversification than in the case of mortgage financing. Both geographic diversification and diversification in type of property are secured. This, it is urged, is significant in view of the exceedingly wide interest which exists in the investment trust movement in the United States at present. While the company under discussion is not an investment trust, its securities have the characteristic of diversification which is the central feature of the investment trust movement.

Notwithstanding these claims, those who favor the mortgage type of financing point to the lack of actual direct mortgage on individual property as a weakness. In actual practice, of course, what is fundamental is not so much what this or that utility executive or financial executive prefers as how the market will evaluate the merits of the respective policies. The market has evidently preferred the mortgage type of financing, until recently, at any rate. Lately, Associated financing has been carried on on a very attractive basis. In a recent interview with Frederick S. Burroughs, a vice-president of Harris Forbes & Company, Mr. Burroughs said:

> Investors encounter no difficulty in using such securities as collateral. They are so well known that an investor can realize on them with the utmost facility. Individual issues against individual properties in the system could not possibly enjoy such a wide reputation or such a universal market. This widespread distribution of the securities of one company reacts in still another way. The statistics of earnings and growth and the value of the wide diversification in territories served, type of industries served and class of utility service rendered become so well known and so generally appreciated by investors that it is possible for the company to market its securities on an increasingly favorable basis. The most recent step in the program of the Associated Gas & Electric Company for bringing its financial structure to the highest point of efficiency was the offering of a new issue of convertible 4½ per cent gold debentures.

It is also urged by advocates of this type of financing that under it a financial panic or other emergency would present less difficulty. Mr. Burroughs said also:

> The type of financing of which the financial structure of the Associated Gas & Electric Company is an outstanding example finds its strength in the fact that, in addition to providing for the current requirements of the system, it supplies a means whereby extraordinary requirements can be taken care of with equal facility on very short notice. The plan contemplates that under normal market conditions the capital required for the extension of the company's system and for the acquisition of additional properties to broaden its scope and business will be provided through the sale of debentures of the parent company, and should funds be required under adverse market conditions, as, for instance, in a period of panic, they can be made available through the sale of the mortgage secured obligations of any of the numerous constituent operating companies.

The Electrical World does not presume to pass judgment on the merits of this less general mode of financing. This the securities markets will eventually do. At a time when funds are not so plentiful as they are today, or in a period of difficulty of any kind, investors will naturally become more critical of offerings. Such a situation will provide the testing time as between the two types of issue under discussion. Past experience shows that the security behind a particular issue is the first thing examined more carefully when the market becomes a buyer's market. Experience would seem to show that in such an event the first mortgage bond will be regarded as of a higher type than the general mortgage bond—the specific security than the general security. Preference for the mortgage type, however, will be limitd by the success with which advocates of holding company financing succeed in selling to the investing public the advantages of this type. It is significant that legislation in those states which allow public utility bonds to be purchased for trust and savings bank investment places emphasis upon mortgage security. This is true in the case of current legislation in Massachusetts, Minnesota and elsewhere. At the same time, investment in unsecured obligations has been authorized for life insurance companies by passage of the Wales bill, and the companies concerned are reported to be buying these securities, actively.

Another Use for Electricity in Building Construction

MORTISING work on the doors of an engineering laboratory in Massachusetts was performed five times as fast as under former hand methods by the use of a motor-driven unit which is clamped to the door frame and supplied with energy by a flexible cable from a convenient outlet. The mortising machine was furnished by the Carter Machine Company, Phoenix, N. Y.

Kansas City "Brightway" Has 963 Lumens per Foot

Equipment gives six times former intensity. Installation promoted by merchants, while city assumes operation and maintenance

By R. A. Graves
Kansas City Power & Light Company, Kansas City, Mo.

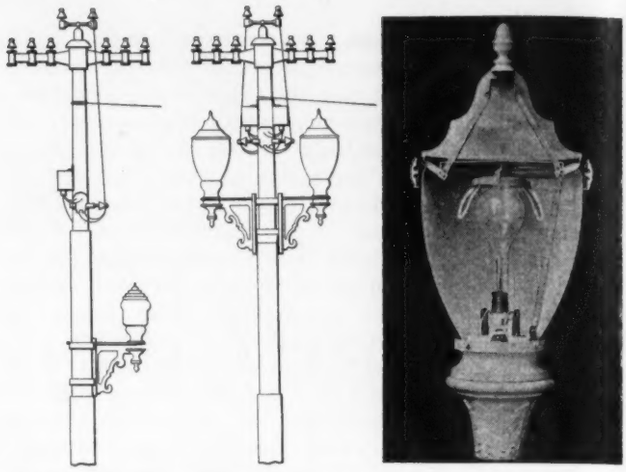
ONE of the active cross-town business streets in Kansas City, Mo., that cuts across every north and south business street was lighted as a new "Brightway" a few months ago. The lighting intensity for the five blocks of this initial installation averages 963 lumens per linear foot of street. This is of the order ordinarily recommended for a well-lighted hotel lobby.

The first section of the installation involves eighty 1,500-cp. lamps within the five-block area with a rated output of 15,000 lumens per lamp, which means that the street is flooded with 1,200,000 lumens, as compared with the former 198,000 lumens. This is only the beginning of an extensive whiteway which will in time, it is hoped, extend across the entire city.

In the working out of this development there were several physical obstacles to overcome and still give the desired lighting results without an unreasonable expenditure. The width of the street is approximately 56 ft. between buildings and 38 ft. between curbs. There is a double-track car line with the necessary trolley poles, upon which the present 600-cp. lamps are mounted together with the railway feeders. Some consideration was given to placing all overhead lines underground. This would have entailed placing the railway feeders as well as the street lighting circuit underground. After some investigation it was found that an entirely new duct line would be necessary to do this and the cost was found to be prohibitive. After considering several different schemes, it was decided that any improvement in the lighting would have to be made by using the present trolley poles with railway feeds as well as overhead series circuits attached.

Trolley Pole Brackets Used

The new units installed consist of two King brackets, similar to the one already used, mounted approximately 19 ft. 8½ in. to light center and so that the top of the glass canopy will clear the trolley support attached to the pole. One bracket is mounted on the street side of the trolley pole and one bracket mounted on the sidewalk side of the trolley pole. Each bracket has been equipped with one 1,500-cp. series street lamp covered with a No. 124 rippled alabaster globe equipped with a "Novalux" rippled alabaster canopy and a 1,500-cp. dome refractor, made by the General Electric Company. The two compensators, as noted on pole, are necessary because of the double circuit of control for the lamps. The lamps on the street side of the pole are to burn all night every night, or approximately 4,019 hours per year. The lamps on the sidewalk side of the pole burn only from one-half hour after sunset until 1 a.m. every night, or approximately 2,330 hours per year for this installation.



Existing single-unit fixtures are replaced by double ones. New 1,500-cp. units with alabaster canopy

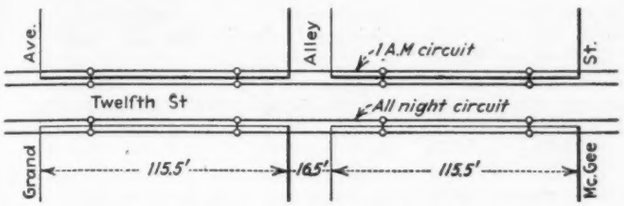
The alabaster canopy has a rather unique method of support so that the globe itself is not subject to undue or severe strain. Extending up from the casing upon which the globe rests is a steel rod, which in turn supports a metal ring upon which the canopy rests, so that when the canopy is set and fastened it also helps to hold the globe in place. The over-all dimension of the globe is 41 in. high with a maximum diameter of 18 in. At present there are in Kansas City a very large number of street lamps on brackets supported by trolley poles and the experience has been that the vibration due to the trolley wire being attached to supporting pole does not materially reduce the life of an ordinary series street lamp nor does it increase to any great degree the hazard to the globes.

The promotion of this installation was inaugurated by the Kansas City Power & Light Company and carried

Twelfth Street as it appeared before revision of lighting system and its present appearance

on by some of the leading merchants and real estate men especially interested in the future development of Twelfth Street.

An agreement was drawn between the Twelfth Street Lighting and Improvement Association and the Kansas City Power & Light Company pledging the co-operation of the property owners and merchants on Twelfth Street to raise the necessary capital to pay the actual cost of installing the "Brightway." The assessments could be paid in cash or extended over a five-year period. This was possible only after the co-operation of the city was assured, so that after the association had paid for the installation the city would assume the operating cost and



Typical block in lighted area showing spacing

lamp renewals as well as maintenance. This the city agreed to do along with its regular street lighting service throughout the limits of the municipality.

Since this initial installation has been put into service and its actual improvement in street lighting seen several of the street associations formed for the improvement of their respective streets are considering a similar installation.

Letters from Our Readers

Takes Issue with Economies of 20-Amp. Street Lights

To the Editor of the ELECTRICAL WORLD:

On page 312 of the ELECTRICAL WORLD for Aug. 18 is an article by W. McKechnie of the Westinghouse Electric & Manufacturing Company recommending the use of 20-amp. series circuit. I take it that the proposal is to run 20 amp. through the entire series circuit instead of 6.6 amp. or 7.5 amp., as is commonly done today, and eliminate the use of series transformers or compensators in the lamp posts.

In calculating the capital cost of the cable Mr. McKechnie does not mention the gage or size, and it goes without saying that with an equal gage the I^2R losses will be considerably higher for the 20-amp. secondary as against the 6.6-amp. secondary.

No. 8 B. & S. gage, solid, paper-insulated, lead-covered, steel-taped 1,500-volt cable can be bought f.o.b. here for $120 per 1,000 ft.; 3,000-volt cable for $180 per 1,000 ft., and, as we are on the Pacific Coast, I take strong exception to the price of $210 per 1,000 ft. shown under the heading of 6.6-amp. secondary; also, compensators manufactured by the Westinghouse company have been bought by this corporation for $9.75 f.o.b. Vancouver, B. C., so why spend $20 for safety coils? As a matter of fact, using No. 8 B. & S. gage, paper-insulated, lead-covered, steel-taped, armored cable, a comparison between 6.6-amp. and 20-amp. lighting equipment might be computed as follows:

The I^2R losses plus the iron wattage losses, per 1,000 ft., are approximately:

Amperage	I^2R Losses	Iron Losses	Total Losses
6.6	30	15	45
20	255	180	435

There is an increase in total losses for No. 8 B. & S. gage, lead-covered, steel-armored cable, grounded, of 390 watts per 1,000 ft. Energy at 1.5 cents per kilowatt-hour would cost 0.58 cent per hour more for operation; or in an operating year of 3,800 hours: 3,800 × 0.58 cent = $22.04 per 1,000 ft. per year. Our circuits are approximately 18,000 ft. in length, and this would mean 18,000 × $22.04 = $396.72 per year more for operation per circuit.

To put compensators in the standard casings would cost us $14 per standard, or for a circuit of 50 standards $700, on which the annual fixed charges on a ten-year basis would not amount to more than $98 per year for the entire circuit.

Summing up as I see it, the increased losses on one of our circuits, operating at 20 amp., would cost us $396.72 per year, or more than half what it would cost to convert all the lamps on the circuit to 20 amp. with the present equipment. Second, if the lamp were changed from 6.6 amp. to 20 amp., our fixed charges would then increase $98 and there would be an increased cost of losses of $396.72.

A great deal has been said about the efficiency of the 20-amp. lamp. There are such things as theoretical efficiency and practical efficiency. It is quite true, perhaps, that you will get a better light output with the 20-amp. lamp and save a few watts, but such saving is very soon dissipated and losses are shown when it comes to maintenance. I have kept an accurate and systematic record for a period of five years which shows that up to and including 6,000 lumens there was absolutely no advantage with the 20-amp. lamp. Over 10,000 lumens the 20-amp. lamp does give better results, but for residential streets the lamp sizes commonly used are 4,000 and 6,000 lumens.

The salesmen for the manufacturers have stressed public liability hazards unduly; in fact, simply raised a bogey which, in my opinion, in many cases has killed proposals for better street lighting. Better street lighting is, in these days of a high traffic density, a necessity, and it is good business to make this service available to residential communities as economically as possible. It is good for the manufacturer, the central-station company and the public at large, and there is no physical, electrical or mechanical reason, other than a few theoretical ideas, why street lighting should be overloaded with a lot of apparatus.

The matter of locating faults in single-conductor cables has been solved. If Mr. McKechnie can convince me that his system with residential spacing of 125 ft. between units can be installed for less than 80 cents a foot, and 4,000 lumen lamps with energy at 1¾ cents operated for $25 per lamp per year, and that his lamp renewals will average less than one and a half lamps per socket per year, then we will change over to the 20-amp. system and not before.

J. W. SOUTHERI,
Municipal Electrical Engineer.
Corporation of Point Grey,
Vancouver, B. C., Canada.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

The Research Institute for Hydraulic and Hydro-electric Structures.—BLAKE R. VANLEER.—A statement of the plans and activities of the "Forschungsinstitut fur Wasserbau und Wasserkraft" is given by the author, and a description of the experimental field which this German institution is endeavoring to cover in connection with hydraulic research, is included. This institution differs from other hydraulic laboratories in that experiments are undertaken on a large scale, and the hitherto acceptable errors may be avoided. A summary of the plans for immediate research, and of the conclusions already derived as a result of a number of determinations, are given.—*Mechanical Engineering,* August, 1928.

Italian Hydro Station Mese.—L. VELLARD.—The North Italian Edison Company, together with several subsidiary hydro-electric holding companies, operates a number of power plants on the rivers Liro and Mera, taking advantage of natural drop and large artificial storage ponds. The largest among these installations is the Mese station, operating under a hydraulic head of 2,500 ft. There are at present three sets of 35,000-hp. Pelton two-nozzle turbines installed, driving 30,000-kva., three-phase generators. Since this station may supply, according to demand, two different transmission lines, one of 42 cycles, the other a 50-cycle system, the turbo-sets are equipped with regulators to maintain either 420 or 500 r.p.m. Each generator is connected to a 30,000-kva. transformer, to raise its 8,000-volt to 140,000-volt transmission potential. Lines of 65 miles and 125 miles connect the station to the city of Milan and to the hydro station Arquata respectively.—*Revue Générale de l'Electricité,* July 28, 1928.

Generation, Control, Switching and Protection

Transformer Protective Devices.—F. RATKOVSZKY. — Operating men have been offered, in recent years, a great variety of protective devices, which are all claimed to disconnect large power transformers in case of trouble. What is more, the claim is made that the tripping is accomplished quickly enough to forestall any major damage. Reviewing the best known protective systems, the author shows that none of them affords a really reliable protection. All of the differential systems, reacting upon either voltage, current or wattage, are not sufficiently sensitive and are far too complicated. Pressure relief diaphragms are a coarse protection and have been known to fail to open for very sudden gas generation. Thermometers in the oil are far too slow, heat exploring coils in the winding are dangerous to the winding. Gas relays of the Buchholz type are too slow, requiring minutes or more to respond, or disconnect frequently due to totally trivial troubles. Since a winding-short is the most dangerous fault in a transformer, and represents 80 to 90 per cent of known breakdowns, the writer suggests an exceedingly simple and effective protection by providing two or four small one-turn coils directly on the core leg, symmetrically arranged along the leg, and counter-connected. The resulting two of four leads are carried to the trip coil of the main circuit breaker. During faultless operation the e.m.f. induced in these coils will be fully compensated, but a very considerable energy will flow through them if, due to a winding short, the flux becomes assymmetric. Tests with this arrangement, made on a 6,000 kva. transformer, indicated a trip of the breaker within one-tenth of a second, and before the windings had time enough to become hand warm.—*Elektrotechnik und Maschinenbau,* July 1, 1928.

Transmission, Substations and Distribution

Developments in Distribution Line Construction. — E. F. HINCH. — Practices which have been adopted by the Hydro Electric Power Commission of Ontario, as leading to improved results are reported. One of the outstanding developments by the commission in distribution work is the adoption of a universal transformer that may be used for 2,200-volt service; for a 4,000/2,300 four-wire circuit connected phase to ground or phase to phase ungrounded; for 4,000 volt three-wire service, and on 8,000/4,000 volt four-wire circuit, phase to ground. The transformer, while a special one, costs but slightly more than the standard devices. The advantages of this device lie largely in the flexibility involved in its use. Several other new and interesting items of equipment have been developed, including a steel clamp insulator pin said to possess many advantages over wood, which may be easily installed, and gives ample latitude for phase spacing. After a year's trial, steel pins have been completely adopted. Solderless connector are used for outdoor work and for general distribution where small service and transformer clamps of special design are utilized. Other developments include a compact clevis and strain insulator and a specially treated ground rod. — *Electrical News (Canada),* July 15, 1928.

Future Overhead Transmission Line Design.—WILLIAM T. TAYLOR. — The reasons for recommending changes in the present methods of design and construction for overhead lines, the problems overlooked in the economical span theory, the safe height of conductors accepted by the author as being the proper one, the factors of safety and reliability of wood pole line construction and comparative tables of flashover values are among the features considered in this discussion. The author differs with a number of contemporary practices and offers data to substantiate the validity of his contentions.—*Electrician (England),* July 20, 1928.

Units, Measurements and Instruments

The Beggs Deformeter.—Numerous proposals are said to have been made in the past to determine stresses in complicated frameworks or other structures by means of measurements made on models. In many cases, however, the requirements of the mathematical theory have been far from satisfied, and in particular there has been a violation of the basic assumption that the form of the structure is not sensibly changed by the imposition of its load. This objection does not apply to an ingenious method of determining stresses by direct measurement of the deformations of a model. This latter plan devised by Prof. Beggs, has been applied to a number of determinations. A model of the arch may be constructed of celluloid and examined for stresses. The Beggs apparatus is based upon Clerk Maxwell's reciprocal deflection theorem. Each deformeter gage consists of two parallel steel bars, in each of which there are two opposing V notches, and the bars are held together by helical springs, which allow a small relative motion between the bars. Gage plugs machined to specific sizes within a close tolerance are provided for introduction between the gage bars, for the purpose of producing a definite amount of thrust, shear or rotative displacement. By observing simultaneously with several microscopes the displacements at various load points of the model produced by applied displacements at sections of unknown stress, ordinates for the deformation lines may be obtained rapidly. The design and application of the instrument is fully described.—*Engineering (England),* July 13, 1928.

Illumination

One Hundred and Twenty-five Years of Incandescent Light.—B. DUSCHNITZ. —The author has compiled all available data covering the gradual development of incandescent light from the year 1802, when Humphrey Davy heated a fine platinum wire to white heat with energy from a number of primary elements, to our latest type of gas-filled, coiled-filament tungsten lamp. From a bibliographic standpoint the article is both

complete and of great value, particularly since it apparently contains neither bias nor nationalism. Former papers of a similar character often involved attempts to accredit the lion's share of the development to one or the other contributing inventor. — *Elektrotechnische Zeitschrift,* July 26, 1928.

Motors and Control

Standard Types of Three-Phase Motors. — O. ZÄHRINGER. — The recently established German motor standards made it desirable to abandon ten to fifteen-year-old designs and to develop a modern line of motors covering a range up to 100 kw. In spite of the requirements, imposed by nine different service classes for such motors, the designers found it possible to reduce frames and bearings to but ten sizes. Utilizing the available standard pieces as a base, a large variety of motors can now be assembled from relatively few stock parts to answer practically all demands within the above cited range. This principle is well described and illustrated.—*Siemens Zeitschrift,* July, 1928.

Double-Cage Motor.—R. BAFFREY.—The writer regrets that the excellent qualities of the double-cage induction motor, introduced twenty years ago by Boucherot, are not being as well appreciated as the features of the design would warrant and feels that the advantages and characteristics of these motors are not sufficiently familiar. A general description is given, emphasizing in particular the favorable starting current, starting torque and simplicity of starting. It is pointed out that such motors can be designed to start under full load without lowering the power factor below 0.5 for the starting period. Combined with a multi-tap starting transformer a double-cage motor has all the good characteristics of a slip-ring motor.—*Elektrotechnik und Maschinenbau,* July 8, 1928.

Heat Applications and Material Handling

Automatic Cadmium Plating. — FAY LEONE FAUROTE. — An application of automatic cadmium plating in the automotive industry is described by the author. Improved quality of plating and economy in material handling and in time are features of the installation. Articles pass through an electric cleaning solution, the first water rinse, the cadmium electroplating tank, and the hot water cleaning or rinsing tank. An unusual mechanical device eliminates the necessity for manual handling and makes dipping a purely mechanical movement. The electric potential is impressed upon the metal parts by means of a special hanger with a contact brush connecting to overhead busbars. Other provisions are made for handling smaller parts in this shop. A special 5,000 ampere generator set supplies the 6 volt direct current used for the plating work. —*Iron Age,* August 9, 1928.

Electrophysics, Electrochemistry and Batteries

New Method to Magnetize Permanent Magnets. — ERICH SCHULZ. — The author places a heavy copper ring around one leg of an ordinary air-insulated transformer and excites the transformer with direct current. When the supply is switched on or off a heavy direct-current "kick" flows through this copper ring. As many as twelve unmagnetized horseshoe magnets are threaded on the copper ring and one closing or opening "kick" is sufficient to magnetize them strongly and permanently. An exact theoretical investigation of this simple and unique method is given, describing in detail and with curves the building up or the collapse of the direct-current field and the ensuing "kick." The method of the field collapse is recommended as more efficient. Particularly for the manufacture of brake magnets for electric meters this method has been found useful, simple and quick. —*Elektrotechnische Zeitschrift,* June 28, 1928.

On Electrical Fields Near Metallic Surfaces. — JOSEPH A. BECKER and DONALD W. MUELLER.—A method of determining the forces on an electron as it leaves a metallic surface from thermionic current-voltage curves with illustrative example for thoriated tungsten. The electrophysical factors involved in the emission of electrons from a metallic field have been covered both as to theoretical and experimental determinations. The authors point out that the photoelectric current should be affected by the surface fields in a somewhat similar manner to the thermionic current. It is also stated that the photoelectric current should saturate poorly with partially covered surfaces and that the long wave length limit should shift toward the red when the applied field is increased from a small value to a larger value. This shift should be more pronounced for partially covered surfaces than for clean or completely covered surfaces. It is indicated to be probable that the details of the surface field can more simply be ascertained from photoelectric than from thermionic effects.—*Reprint B-300, Bell Telephone Laboratories, Inc.*

Traction

The Electric Supply of the German Railways.—W. REICHEL.—In the first part of his paper the author describes the requirements imposed by railway load upon motor generators, converters and cascade type alternating-current-direct-current sets, comparing their performances. The maximum possible output of these machines exceeds by far present requirements. In the second part mercury-arc rectifiers of the large steel vessel type are compared. They combine the advantages of the three rotating machine types with few and quite insignificant weaknesses. Their maximum output answers today all railway requirements. Details are given on their latest construction, in particular the maintenance of the vacuum and the elimination of back ignition. An interesting tabulation, comparing 27 features of the three machine types and the rectifier, gives a comprehensive comparative study of these units, for which fully equal reliability is claimed.—*Elektrotechnische Zeitschrift,* June 14, 1928.

Telegraphy, Telephony, Radio and Signals

Glow Tubes as Rectifiers.—G. SEIBT. —For direct current of less than one ampere, such as required for charging small batteries and for radio purposes, the glow tube rectifier is gradually superseding all other types on account of its reliability, small size and absence of maintenance. For the design of such glow tubes two characteristics are of basic importance, the drop on the cathode and the ionization voltage. The former depends upon the electrode metal or rather electrode surface, the other upon the gas in the tube. These characteristic voltages are given for twelve metals and six gases. The valve action of the tubes is further greatly affected by the relative size of the two electrodes; that is, a small anode is usually used with a much larger cathode, and to obtain rectification of both halves of the alternating-current cycle two anodes are usually arranged with one cathode, giving three electrodes per tube.—*Elektrotechnische Zeitschrift,* July 19, 1928.

Miscellaneous

Rectifier for Electric Plant Culture.—P. JACCARD.—A small portable vacuum tube rectifier is described for an experimental study of growing staple food plants in an electrostatic field of 2,000 volts direct-current. Galvanized iron wires stretched about 8 in. above the plants distribute the charge. As the plants grow the wires are raised accordingly. No claim is made for the conclusiveness of these tests on a small scale, although all of them indicated a decided increase in the final harvest value. Barley gave as much as 61 per cent more and wheat up to 24 per cent more than the non-electrified comparison plantings.—*Bulletin de l'Association des Electriciens,* July 22, 1928.

Architecture in Industry.—FREDERIC TOWNDROW.—That great industries demand fitting architecture for works and premises is the theme of this article. The author urges more attention by architects and engineers to the essential character of power stations. Specific examples of contemporary stations on the continent and in England are illustrated to support the author's contention that generating stations can be esthetically satisfactory additions to the community. The relationship of the architects to the engineers in such work and the specific problems involved in applying architectural principles in engineering jobs are pointed out.—*World Power (England),* August, 1928.

Book Reviews

Transformer Construction and Operation

By Emerson G. Reed. New York: McGraw-Hill Book Company. 213 pages, illustrated.

Transformer construction and practice is in a state of constant flux and this book gives a general descriptive treatment of transformers from the point of view of an engineer with a transformer manufacturer. It grew out of a series of lessons used by the Westinghouse educational department.

Descriptive material on modern transformers is useful, but the author might well have given more design and performance data whereby an engineer might make quantitative studies of transformer types. The general exposition is elementary and non-mathematical. Well-chosen illustrations aid in presenting the material. The practical nature of the book should make it very useful to students and operators of transformers.

Elektrische Vollbahn Lokomotiven

By Karl Sachs, engineer of Brown, Boveri Works. Berlin, 1928: Julius Springer. 461 pages with 448 illustrations and 22 large drawings.

With an admirable thoroughness, the author of this large and minutely detailed tome has gathered and logically arranged all available material on modern electric main road locomotives. From all civilized countries the latest achievements and most modern designs are cited as examples and described in their proper place. No space is wasted with history or the leading up to present types. Neither is the book confined to the electric propelling part itself; it covers with the same careful detail the mechanical end and all accessories as well.

Whether the subject under discussion is a main driving motor or the pantograph, the hand brake, the coupling bar or the compressed air whistle, all parts are exhaustively treated according to their importance. After preliminary chapters on road resistance, road diagrams and mechanical parts common to all types of locomotives, a further segregation is made in chapters on direct-current, alternating-current, three-phase and converter locomotives. It is to be welcomed that the author did not attempt a partisanship of any one particular current system. A remarkable number of data have been collected covering the subject of mechanical power transmission from motors to drivers. But here again from the host of ingeniously devised flexible drives only those which have proved their value on actually built engines have found their way into the present book. Examples of its completeness are elaborate information on braking methods, compressor motors, a whole chapter on transformer tap switches, engine and train illumination, current collectors, pole changing on three-phase motors, etc. A description of fifteen modern types of locomotives of German, Austrian, Swiss, French, American and Italian design makes up the last chapters. An expensive but highly valuable addition to the book is 22 large, folded drawings, giving electromechanically complete assemblies and wiring diagrams of some of the described engines.

Engineering Education—Essays for English

By Ray Palmer Baker. New York: John Wiley & Sons. 233 pages. Second edition.

In the rearrangement of this book Dr. Baker follows the scheme of the first edition, but stresses the relations between science and society. This series of essays about and by notable engineers and scientists gives more than a copy style for writing; it gives an introduction to dominating ideas that should stimulate the student. Newcomb, Desch, Hammond, Johnson, Harrington, Spencer, White, Poincaré, Patterson, Millikan, Rose, Senier, Shotwell and Russel are names to call forth homage. These men truly develop values in education as well as in English.

Protection Contre les Effets Nuisables de l'Electricité

By F.-G. de Nerville et A. Hardy. Paris: Encyclopédie de l'Electricité Industrielle. J.B. Baillière. 860 pages, 279 illustrations.

The quantity of material published since electrical energy began to be practically applied on what may be paraphrased from the title of this book as "nuisance effects" is sufficient evidence of perennial interest in the subject. The information has, however, been so scattered through technical literature that much search is required to find it. To have a great mass of it assembled in one book is therefore distinctly helpful. The authors do not claim to offer their own solutions for the various troubles that arise when the current departs from the paths assigned to it. They set out to produce a documentation. In this they have been successful. The volume might be designated as a "case book." It begins with physiological effects and describes methods of resuscitation. (The pulmotor is not mentioned.) Other chapters deal with methods of grounding, lightning protection, stray earth currents, inductive disturbances on communication circuits and industrial circuit control. Examples are cited in profusion; methods of surmounting or preventing difficulties are described; legal requirements are quoted. There is a generous bibliography of references to books and particularly to periodicals, predominantly French, but American sources are by no means ignored.

Book Notes

A First Course in Physics for Colleges. By R. A. Millikan, Ph.D.; H. G. Gale, Ph.D., and C. W. Edwards, M.S. Boston: Ginn & Company. 676 pages. Price, $3.72.

A comprehensive survey of the outstanding principles and applications of modern physics is embodied in this book, which is designed to occupy a full year's work in this field by college students. The authors have exercised their powers of selection with skill and a keen realization of the vital relationship between physics and modern electrical and mechanical engineering. The usual range of topics is covered and the problem method is employed extensively to tie the student's thinking about principles into practice. The sections on light, electricity and radioactivity are especially clear-cut. The book is a refreshing contrast to many earlier texts set forth in terms rather remote from everyday applications. It is perhaps too elementary to be of much service to the seasoned professional reader, but should be a tower of strength to many workers in the electrical field seeking a solid physical foundation for more advanced reading and study.

Hochfrequenz Mess Technik. By August Hund, Washington, D. C. Berlin, 1928: Julius Springer. Second edition. 526 pages with 287 diagrams.

The many advances made in the last few years on the subject of high-frequency oscillations forced the author to augment the first edition of his book, issued in 1922, with a modernized second edition. The most valuable additions are an extended theory of the horizontal antenna, the theory and construction of radio filters, precision measurement of wave lengths and detailed information on the piezo-electric generator and resonator.

Code for Electricity Meters.—This, the third, edition of the Code for Electricity Meters is a completely revised and rearranged compilation of the second edition, issued in 1912, and the section on demand meters, issued in 1920. The 1912-20 edition of the code was approved as American standard by the American Engineering Standards Committee in July, 1922 (C12-1922). The present revision has been made under the joint sponsorship of the Association of Edison Illuminating Companies, the National Electric Light Association and the U. S. Bureau of Standards by a sectional committee representing all interested organizations, in accordance with the procedure established by the American Engineering Standards Committee for the revision of American standards. Its contents cover definitions, standards, metering, specifications for acceptance of types of electricity meters, specifications for acceptance of types of auxiliary apparatus for use with meters, installation methods, watt-hour meter test methods, laboratory and service tests, and demand meters.

Book Received

Practical Radio. By Moyer and Wostrel. New York: McGraw-Hill Book Company, Inc. 378 pages, illustrated. Price, $2.50.

News of the Industry

Two More Presidencies for Matthew S. Sloan

Matthew S. Sloan, president of the Brooklyn Edison Company since 1919, who, as reported last week, was on Aug. 28 elected also president of the New York Edison Company, was on Sept. 4 elected to head a third metropolitan utility—the United Electric Light & Power Company. Nicholas S. Brady, chairman of the board, resigned from the presidency to permit Mr. Sloan to become president. On Thursday, Sept. 6, the directors of the New York & Queens Electric Light & Power Company elected Mr. Sloan to the presidency of that corporation, which was vacant. This makes him operating executive of all four of the major electrical units of the Consolidated Gas Company of New York.

Trade Commission Questionnaire Ready Soon

As this is written, 191 of the 225 pages that will compose the Federal Trade Commission's economic questionnaire have been printed. Indications are that the document will be in the hands of financial, operating, engineering and construction companies by the middle of the month. For elaborateness it is believed that this questionnaire never has been equaled in the history of federal inquiries. Representatives of the industry estimate that it will require the greater part of a year to gather the information requested. Statisticians believe that a much longer time will be required by the commission to work up the information and present a composite picture of the situation.

The character of the questions contained in the sheets is such that only those intimately familiar with the accounts of the companies could formulate the return. This means that it will have to be done with the regular accounting staff of each company. New personnel could not be employed to advantage. As the accounting departments of virtually all of the companies concerned already are overburdened, representatives of the industry think many months necessarily will be required for compliance.

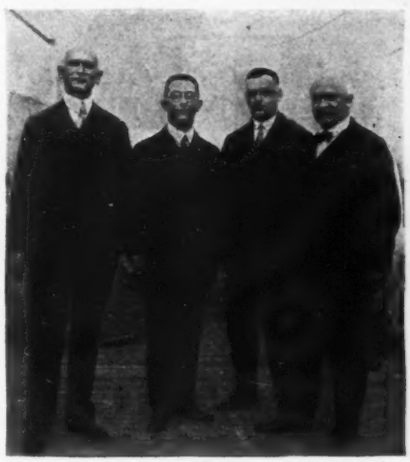
Names for Lamme Medal Received Till Oct. 15

The gold medal to be awarded annually by the American Institute of Electrical Engineers under a provision in the will of Benjamin G. Lamme appropriating $6,000 for this purpose will be bestowed for the first time this year. It is to be given to a member of the Institute "who has shown meritorious achievement in the development of electrical apparatus or machinery." By-laws governing its award, prepared by the Lamme medal committee, were recently adopted by the A.I.E.E., but the time in which they provide that names shall be submitted would be so short this year that an extension to Oct. 15 inclusive has been made. Up to that time nominations for the medal will be received by the committee.

Foreign Members of Lighting Body Here

Sixty-five Delegates from European Countries and Japan Arrive and Are Entertained in New York Before Starting on Tour of East and Middle West

FOREIGN delegates to the International Illumination Congress to be held at Lake Saranac, N. Y., on Sept. 22-28, following the convention of the Illuminating Engineering Society at Toronto on Sept. 17-20, have arrived in the United States. They number 65.



German delegates to International Illumination Congress

Left to right—Dr. Ing. L. Bloch, Dr. Marcello Pirani, Ludwig Schneider, Wilhelm Wissmann.

Welcome to these engineers was extended in New York on Tuesday at two events. The first of these was a luncheon at the Hotel Astor, where the delegates made their New York headquarters. At this luncheon Dr. Clayton H. Sharp, technical director of the Electrical Testing Laboratories, made a brief address of welcome to which M. C. C. Paterson of London, president of the International Commission of Illumination, responded.

John W. Lieb, senior vice-president of the New York Edison Company and president of the Electrical Testing Laboratories, welcomed the delegates at a dinner at the laboratories building, Eightieth Street and East End Avenue, and described the operation of the laboratories as an aid to the electric industries. Following the dinner the delegation visited Times Square and viewed the display of electric signs and later went to the Roxy Theater to inspect the stage lighting there.

On Tuesday afternoon the delegates were taken on sightseeing expeditions in New York City; on Wednesday there was an automobile trip through Westchester County and an evening trip to Coney Island; on Thursday the Edison Lighting Institute at Harrison, N. J., and the Edison laboratories at West Orange, N. J., were visited, and on Friday morning a special train was to take the visitors and their hosts to Boston, the first stop in the tour which precedes the Toronto convention. The itinerary of this tour, which extends as far as Chicago, was printed in the ELECTRICAL WORLD for Aug. 18 (page 323).

Thomas A. Edison is honorary chairman and John W. Lieb chairman of the general reception committee. Arthur Williams is chairman of the New York reception committee, which includes Walter R. Addicks, Nicholas F. Brady, George B. Cortelyou, H. M. Edwards, Oscar H. Fogg, E. M. Herr, John W. Lieb, Norman Macbeth, Thomas E. Murray, E. H. Rosenquest, A. L. Salt, M. S. Sloan, Frank W. Smith, H. L. Snyder, Gerard Swope and Philip Torchio. Clarence L. Law is chairman of the entertainment committee and Mrs. N. F. Brady is honorary chairman and Mrs. J. W. Lieb chairman of the New York hostesses' committee.

Following are the names of the foreign delegates now on tour, many of whom are accompanied by their wives and other members of their families:

Austria—Joseph Kreminezky, I. Schlogl, Dr. Bausenwein.

England—M. C. C. Paterson, Major J. W. Buckley, H. W. Jones, Dr. J. W. T. Walsh, J. R. Thomas, W. E. Bush, Dr. W. M. Hampton, P. Good, L. B. W. Jolley, Prof. J. T. Macgregor-Morris, J. W. Ryde, Major G. H. Spittle, E. J. Stewart, C. P. Banham, J. N. Henshaw, J. M. Waldram, G. Wilson, J. F. Colquhoun, A. Goddard, C. W. Sully, R. Watson, R. Unwin, T. C. Keeley.

France—Prof. James Chappuis, Miss Bloin, M. F. Cellerier, Prof. J. Blondin,

M. Maurice LeBlanc, M. R. Jouaust, H. Maisonneuve, A. Gouffe, G. Reclus, Maurice Exelmans, Robert de Valbreuze.

Germany—Dr. L. Bloch, Dr. H. Nissel, Prof. Dr. M. Pirani, L. Schneider, J. J. Schneider, W. Wissmann, Prof. J. Teichmuller, Dr. Fritz Zimmer, Dr. H. Adolph, Dr. W. Dziobek, Director K. Lempelius, Dr. A. Meyer, Herr Director George Warfelmann.

Holland—N. A. Halbertsma.

Japan—Dr. N. Yamaguchi, Toru Motono, M. H. Konishi, T. Hirohashi (meeting two delegates at Philadelphia, R. Takai and M. Kanaya).

Russia—M. Zelentsoff.

Sweden—H. A. Jerker-Henke.

Switzerland—Louis E. Trolliet, A. Filliol, E. Payot, W. Trub, E. Tobler, C. A. Atherton.

Pennsylvania Association at Bedford Springs

For its twenty-first annual convention the Pennsylvania Electric Association once more assembled at Bedford Springs, Pa., on Wednesday, Sept. 5. The only event on the opening day was the reception to President and Mrs. John S. Wise, Jr., in the evening. For Thursday and Friday the following program was arranged:

THURSDAY, SEPT. 6

Morning—General Session: President's address; committee reports.

Afternoon—Engineering Section: Review of the year's work, G. S. Humphrey; addresses, B. F. Cleaves, Penn Central Light & Power Company; N. E. Funk, Philadelphia Electric Company; Charles F. Kettering, General Motors Corporation; S. M. Kintner, Westinghouse Electric & Manufacturing Company; committee reports. Ladies' Session: Review of the year's work, Clara Zillessen; addresses, P. H. Gadsden, United Gas Improvement Company, and Miss Isabell Davie, N.E.L.A.; group discussion.

Evening—Public Policy Meeting: Address, P. S. Arkwright, president N.E.L.A.

FRIDAY, SEPT. 7

Morning—Committee reports; Accounting Section: Review, G. U. Stewart; address W. B. S. Winans, H. L. Doherty & Company; committee reports. Public Relations Section: Review, J. H. Shearer; addresses, P. S. Clapp, N.E.L.A.; Edmund W. Wakelee, Public Service Company of New Jersey; Miss Eloise Davison, N.E.L.A.; committee reports.

Afternoon—General Session: Committee reports; award of W. H. Johnson prize. Commercial Section: Review, R. H. Powers; addresses, J. H. Van Aernam, New York Power & Light Association; A. K. Baylor, General Electric Company; Charles F. Stuart, Northern States Power Company; one other not announced.

Power Exportation Figures in Maine's Election

Next Monday, Sept. 10, Maine will hold its state and congressional elections. Interest centers largely in the contest for Governor, and this revolves in part around the question of permitting hydro-electric power to be exported. The Democratic candidate, Edward C. Moran, Jr., calls this the main issue and seems out of accord with the state platform of his party, which says:

"We desire to pledge our party to the utmost protection of our water power for industrial and agricultural uses within the state, and we believe it is legally possible to do so and yet permit the sale of surplus power outside the state, thereby providing for the speedy development of this resource. Consequently we urge the enactment of carefully framed legislation permitting the transmission of surplus hydro-electric power outside the state, with adequate provision that Maine industries now and hereafter shall have first claim upon the same."

The Republican platform pronounces the water-power question one of vital importance to the state and urges that the next Legislature be intrusted with power to create some agency for the investigation of the facts with regard to the power resources of the state and promptly legislate in accordance with the findings thus arrived at. "This convention," the water-power plank concludes, "makes no recommendation on this issue other than, pending an investigation such as is herein outlined, to reaffirm the position already taken by the Republican party of this state that the state should in no wise surrender its control over the water-power resources within its borders."

Danger to the Fernald act, prohibiting exportation, is seen by Mr. Moran and those who are supporting him on the issue he raises.

Power Commission Gets Protest from Porto Rico

A protest against the issuance of a license to the Porto Rico Railway & Light Company has been filed with the Federal Power Commission by M. Argueso. He contends that the license covers all water power of value in the island and will give the company an absolute monopoly in the matter of large-scale power development. The commission is awaiting a statement of pre-license costs from the Porto Rico company and will take no action on the application for license until such a statement has been approved.

Arizona's Board of Directors of State Institutions has applied to the Federal Power Commission for a preliminary permit covering the site on the Little Colorado River, near Flagstaff. It is proposed to construct a dam at the Tolchico site, with an alternate proposal of two dams so as to provide for the ultimate development from the Tolchico site to the Colorado. This would provide a head of 2,000 ft. The proposed reservoir would have a capacity of 700,000 acre-feet, but the applicants do not estimate the power which would be made available. This is the fifth application made by the board in the development of its systematic plan for harnessing the Little Colorado River.

The commission has issued a license to the Bunker Hill & Sullivan Milling & Mining Company which allows it to construct a 350-hp. plant on the Deadwood River, near the company's mining property.

The Champion Sillimanite Company of Bishop, Calif., has applied to the commission for a license covering a water-power project on Milner Creek, near Bishop. It is proposed to divert the entire natural flow of the creek through a conduit 10,000 ft. long to the power house, operating under an 80-ft. head. In this way 225 hp. will be developed for use in the mining property of the applicant.

Kentucky Reaction to Cumberland Falls Report Slight

If the press in Kentucky reflects public opinion, the great majority of the people of that state are apparently indifferent either to the development of power at Cumberland Falls or to the exclusion of all commercialism from that portion of the Kentucky River. A review of Kentucky newspapers made by the Kentucky Utilities Company for the two weeks' period beginning Aug. 17 shows that 106 of the 192 newspapers in the state failed to give any space to the report of the commission's executive secretary. Fourteen papers favored the development and an equal number were active in opposing it. Copies of the 58 remaining papers in the state had not been obtained at the time of the review mentioned.

The report had, none the less, the effect in Kentucky of prompting the Rev. C. E. Vogel, the president of the Cumberland Falls Preservation Association, to send out an appeal urging that the people protest against "selfish commercialism and unscrupulous politicians," and it was all that was necessary to arouse the National Federation of State Park Associations, which sent out an "S.O.S." intended to start anew the opposition which has been waged against this project.

Power and Highway Interests Often in Conflict

An increasing number of conflicts are arising between officials in charge of highway construction and development and those dealing with the utilization of water resources, Washington advices say. The construction of dams in streams and the creation of large reservoirs adds to the expense and difficulties involved in carrying roads across or around such reservoirs. In the West the reservoir areas usually are controlled by the Department of Agriculture through the existence of national forest reserves or by the Federal Power Commission through power-site reserves. The solution involves an intricate economic analysis to determine whether or not it is in the public interest to give the highway an interior location or to build a bridge and add the cost to the rates which will be charged those who use the water for irrigation purposes or those who will have it added to their electric power bills.

The application of the Empire District Electric Company, which involves

the construction of the Table Rock reservoir on the White River, in Missouri, is being indefinitely delayed because the power company would not be justified in making the development if it has to pay for a bridge necessary to the continuation of direct highway communication with the adjacent territory on the two sides of the stream. Cases of this character present unusual difficulties to the commission.

A case involving the same fundamental questions is had in the conflict between Los Angeles and Pasadena in connection with the proposal of Pasadena to construct a water supply-reservoir in the San Gabriel River below the site of the flood-control reservoir, which Los Angeles plans to build. Pasadena finally has obtained rights to construct its reservoir, despite the fact that this will make necessary a much larger expenditure in the construction of the Los Angeles project, since the railroad necessary for transporting materials will be prevented by the Pasadena reservoir from following the edge of the stream and will have to occupy a much more difficult location where construction costs will naturally be much greater.

How Power Dams Saved the Day in the Carolinas

In an account of the recent storms in the Carolinas the *Southern Public Utilities Company Magazine* points to the proved value of hydro-electric development in regulating river flow and thus preventing floods or mitigating their effect. Finding only two instances of damage to Duke power plants to record—these being caused by flooding in the Gaston Shoals plant of the South Carolina Gas & Electric Company on the Broad River near Spartanburg, S. C., and the Portman Shoals plant of the Southern Public Utilities Company on the Seneca River near Anderson, S. C.—the paper says:

"The power system of the Duke Power Company on the Catawba River and private property owners on this stream came through with flying colors because of the tremendous amount of storage behind the various dams on that stream."

In this connection it quotes from the Gastonia (N. C.) *Gazette* an article comparing the harm done by this year's storm with that done by a similar storm in 1916. In part this article says:

The Southern Power Company dams have saved this section from the ruin and devastation of another flood. In 1916 the same conditions prevailed and not a bridge was left between the mountains and Camden, S. C., on the Catawba River. There was not a dam on the river above the original Fort Mill dam, which was completely submerged, and the torrents of water, rushing madly down the streams, had full sweep as they carried bridges, dams, trestles, etc., before them.

This year the big dams at Rhodhiss, Bridgewater, Mountain Island and at other points have checked the flow of the water and have held it in restraint, so that there has not been the resultant damage from floods and freshets. The difference can be seen here in Gaston County on the South Fork and the Catawba. The latter stream is behaving nicely compared to the antics of the smaller tributary. There is no damage to speak of on the Catawba, while the South Fork is causing quite a bit of destruction in the wake of its muddy waters.

Twelve years ago the entire section of the county between the South Fork and the Catawba Rivers was cut off from the rest of the world for several days. Bridges and trestles were washed away, also telephone and telegraph wires and other means of communication. People were marooned in the mountains for days before they could get away, so badly torn up were the dirt roads of that day and time.

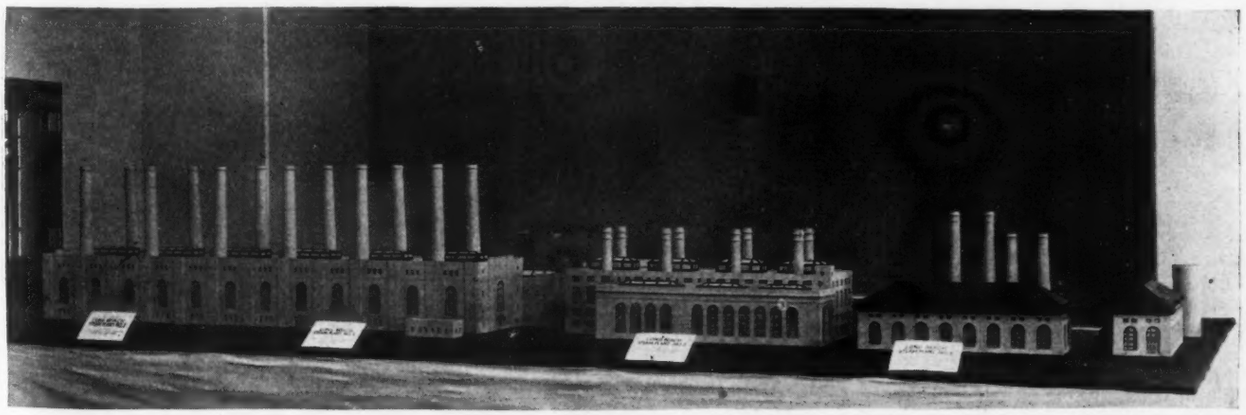
Ontario's First 220-Kv. Line to Be Ready Oct. 1

According to a report issued by the Ontario Hydro-Electric Power Commission, the total estimated cost of the transmission line between Toronto and the Gatineau Power Company's plants on the Gatineau River in the Province of Quebec, and of the transformer station at Leaside, Ontario, was about $14,000,000, and the estimated cost of the initial installation is $6,604,300, divided into $3,330,700 for the 220-kv. line, $2,868,000 for the 220-kv. terminal station and $405,600 for the interconnection of the two systems. The amount of power available under the contract with the Gatineau Power Company is 260,000 hp.

"The problem of transmitting this block of power 230 miles to Toronto and there providing an interconnection with the present system was practically entirely new," reads the report, "few systems in the world today providing a parallel case which would provide a check on any decisions made. Economic and engineering studies were undertaken, and, based on these studies, it has been decided to provide two single-circuit transmission lines with 795,000-circ.mil conductors operating at 220,000 volts with 180,000 kva. of transformers in four banks of 45,000 kva. each, stepping down at Toronto."

The first of the two lines is, as before reported, now being constructed by the commission's construction department. In the 202 miles in Ontario there are 994 towers. The construction of the transmission line is about completed, and expenditure shows that this work has been carried out under the estimate, including all the overhead, interest during construction and administration. The line will be completed by Sept. 20 in sufficient time for testing before commencing operation on Oct. 1.

Miniature of the Ultimate Long Beach Steam Plant of California Edison



HERE is a model of the Long Beach steam plant of the Southern California Edison Company as it will appear if the present program, including eight 93,750-kw. units, is carried through to completion. The two buildings on the right of the picture with the dark roofs constitute the original plant, built in 1912-13. This plant has six generators with a total capacity of 70,000 kw. The building in the center is known as plant No. 2 and was built during 1925-27. This plant houses three turbo-generators with a total capacity of about 146,000 kw. On the left is the plant intended to house the eight big units. One of these units is already in operation.

Canadian Mines Consume Much Power

Up-to-Date Report Shows Heavy Demand in Northern Ontario, Southern British Columbia, Quebec and Other Parts of the Dominion

ACCORDING to a report on power in mining just compiled by the Natural Resources Branch of the Interior Department of the Canadian government, the largest single power-using area in the Dominion is the northern Ontario mining district, in which the gold mines of Porcupine and Kirkland Lake, the nckel-copper mines of Sudbury and the silver camps of Cobalt, South Lorrain and Gowanda utilize considerably over 100,000 hp. Of this, gold producers use over 55 per cent, nickel mines 35 per cent and silver properties less than 10 per cent. The principal power developments supplying this area are found on the Mattagami, Quinze, Montreal, Spanish and Wanapitei Rivers. At the Big Eddy dam near High Falls on the Spanish River a 28,000-hp. installation is under way.

A territory which rivals northern Ontario in its consumpton of hydro-electric power for mining is the Kootenay River district, in southern British Columbia. Here the mines, which include the large Sullivan lead-zinc mine, and a great metallurgical plant at Trail utilize a large proportion of the 95,000 hp. developed. A further 60,000 hp. is being developed at South Slocan, on the Kootenay. In addition, the Britannia copper mines near Vancouver, the copper mines and smelter at Anyox and the coal mines on Vancouver Island, in the Nicola-Princeton district, in the East Kootenays and in Alberta near the British Columbia boundary were all important contributors to the 1927 total of 275,000 hp. consumed by the mining industry in British Columbia, which is nearly half of the total hydro-electric power developed in central electric stations in that province.

In the eastern townships of Quebec the asbestos mines are supplied with power from Shawinigan Falls and a development on the St. Francis River. The nickel refinery at Port Colborne, Ontario, consumes considerable "white coal" from the Niagara Falls system. In the Yukon virtually the entire output (13,000 hp.) of developments on the Klondike River and Twelve-Mile Creek is absorbed in gold-mining operations. The growing power requirements of the main section of the Rouyn district in northwestern Quebec are now taken care of from a development on the Quinze River, which together with other undeveloped sites on that river is stll capable of considerable expansion.

Important mining developments now under way in northern Ontario, notably in the Sudbury Basin area, will be supplied from existing installations and numerous undeveloped powers on the rivers of the Upper Ottawa and Mattagami basins. In the Red Lake gold area of northwestern Ontario numerous falls on the English River system are more than capable of supplying power requirements, while the adjoining central Manitoba mining district is well served over a power line from Great Falls on the Winnipeg River. The Flin Flon and Sherritt-Gordon mining projects in northern Manitoba are also fortunate in having several large potential sources of power available. These include Island Falls (76,000 hp.), 55 miles from Flin Flon, on the Churchill River, and Whitemud Falls (180,000 hp), 180 miles from Flin Flon, on the Nelson River.

In the maritime provinces the revived activity in gold mining in Nova Scotia is providing an incentive for the development of water-power sites on several streams and rivers. The Lake George antimony project in New Brunswick will also require power.

A.I.E.E. Atlanta Program Takes Shape

Definite shape has been given to the program of the regional meeting of the American Institute of Electrical Engineers which will be held at Atlanta on the last three days of October. Four general subjects will be covered in the technical sessions. These are power development, power-system operation, communication and textile applications. There will be papers also on translations between sound and light, radio broadcasting, insulator flashover, dynamo design and photoelectric and glow-discharge devices. The tentative program follows:

MONDAY, OCT. 29

Morning. — Student Activities Session: Five student papers and general discussion.

Afternoon—Power Developments Session: "Central Power Station Service," W. S. Lee, Duke Power Company; "Development and Operation of the Southeastern Power & Light System," A. T. Hutchins, Southeastern Power & Light Company; "Translations Between Sound and Light," J. B. Taylor, General Electric Company.

Evening—General Session: Presentation of cup for best student paper; remarks, P. S. Arkwright; "The Existing Radio Problem," Judge E. O. Sykes; "Science and Research in Telephone Development," S. P. Grace, Bell Telephone Laboratories, Inc.

TUESDAY, OCT. 30

Morning—Communication Session: "Carrier-Current and Supervisory Control on Alabama Power Company's System," E. W. Robinson and W. I. Woodcock; "Line Characteristics for Carrier Communication," C. A. Boddie and R. C. Curtis, Westinghouse Electric & Manufacturing Company; "Impulse Flashover of Insulators," J. J. Torok, Westinghouse Electric & Manufacturing Company; "Magnetic Skin Effect in Dynamo Steel," D. P. Savant, Georgia School of Technology.

WEDNESDAY, OCT. 31

Morning — Textile Session: "Variable-Speed Spinning of Cotton Yarns," E. A. Untersee, General Electric Company; "Motor Drives for Cards and Roving Frames," H. W. Reding, Westinghouse Electric & Manufacturing Company; "Electrification of the Textile Industry in the Southeast": (a) "Relation of the Public Utility to the Textile Mill," A. G. Stanford, Robert & Company; (b) "Application of Electric Drive in the Textile Mill," E. M. Clapp, Central Georgia Power Company.

Afternoon — Power Operations Session: "Power-Limit Tests on the Southeastern Power & Light Company's System," Murray Jones and Robert Treat, General Electric Company; "Application of Auto-Oscillograph Equipment for Power Systems," A. Dovjikov, Westinghouse Electric & Manufacturing Company; "Photoelectric and Glow-Discharge Devices," J. V. Breisky and E. O. Erikson, Westinghouse Electric & Manufacturing Company; "Short-Circuit Testing on Alabama Power Company's System, Its Procedure and Effects on Operation," H. J. Scholz, Southeastern Engineering Company, and C. B. Hawkins, Alabama Power Company.

Purchases and Mergers

Filing at Nashville of a copy of the charter of the West Tennessee Power & Light Company (incorporated in Florida) indicates the absorption by it of a group of small electric light and power plants in Tennessee, as well as ice plants, gas works and street railways. Headquarters of this company are at Ripley, and it has hitherto been reported as serving that city, Henning and Munford. To these plants have been added others in Jackson, Brownsville, Mercer, Whiteville, Pinson, Henderson, Medina, Gadsden, Halls, Gates, Atoka and Brighton, most of which belonged to the Jackson Railway & Light Company. The electric plant and distribution system at Humboldt has been leased. The West Tennessee Power & Light Company is a subsidiary of the National Power & Light Company, New York.

Election of Everett W. Sweezy of Alliance, Ohio, as president of the Service Utilities Company brings close together this new concern, capitalized at $12,000,000, and the Suburban Light & Power Company, of Cleveland, capitalized at $5,000,000, which was purchased by Mr. Sweezy about a year ago. The Service Utilities Company controls telephone systems, city ice plants and an electric railway. The Suburban Light & Power Company includes the General Light & Power. It owns light and power systems in various parts of Ohio furnishing electricity to more than a score of towns and cities. The Stark Electric Railroad Company of Alliance, which is associated with the Suburban Light & Power, controls the Alliance Power Company. The latter produces more than 10,000,000 kw.-hr. a year for sale.

Stockholders of the Fort Smith Light & Traction Company have approved the sale of the company's electric and railway properties and its interest in the Mississippi Valley Power Company, a subsidiary, to the Standard Gas & Electric Company, according to the proposal reported in the ELECTRICAL WORLD for Aug. 25 (page 376).

Directors of the Litchfield (Conn.) Electric Light & Power Company and of the Washington (Conn.) Electric Light & Power Company will hold a joint meeting soon to vote on a proposed merger. At present the Washington company is leased by the Litchfield company.

The Iowa Power & Light Company has closed negotiations for the purchase of the Oak Grove Electric Company, operating in Bloomfield township.

Negotiations lasting several months have brought the sale of the Louisa County Light & Power Company, Mineral, Va., to the Virginia Public Service Company of Charlottesville, whence lines will eventually be extended to Louisa and Mineral.

On approval of the taxpayers of the village of Old Forge, N. Y., the municipal power plant has been sold to A. A. Lowe. Approval of the Public Service Commission is sought.

The Commonwealth Utilities Corporation has asked the Colorado Public Utilities Commission for permission to take over the municipally owned electric plant at Castle Rock, Colo.

Senator Norris Thinks Bill on Muscle Shoals Is Law

Writing to Carl D. Thompson, secretary of the Public Ownership League of America, Senator G. W. Norris of Nebraska, whose Muscle Shoals bill remained unsigned in the President's hands ten days after Congress adjourned and has therefore been held to have suffered a "pocket veto," draws attention again to the case now before the Supreme Court of the United States in which it is contended that such action by the President following the first session of a Congress does not kill any bill but, on the contrary, makes it a law, the "pocket veto" being applicable only when a Congress comes to an end after the second, or "short," session has terminated. If the Supreme Court upholds this contention, which has never been passed upon, then Senator Norris' Muscle Shoals bill is already a law. The Senator says:

"I realize very fully that the court might go either way. My own investigation, however, has led me to the conclusion that, both by reason and authority, the bill became a law at the expiration of ten days after its passage. We cannot, of course, rely on this, because it is, as I fully know, an uncertainty, but I anticipate that the Supreme Court will pass on the question some time within the next year, possibly before a new Congress assembles."

Boulder Dam Favored by Secretary West

The new Secretary of the Interior, Roy O. West, who succeeded Secretary Work, announced orally at Washington last week that he will support the Boulder Dam project if a feasible plan for that method of Colorado River development can be worked out. Mr. West added that he recognized the nature of the task of the special engineering commission appointed to draft a report on the project.

Utility Publicity and National Educational Association

The superintendent of schools of a large Eastern city seems the likely choice for the position of chairman of the committee appointed by the National Educational Association to draw up a form of procedure for handling publicity material submitted to schools. Dr. Uel W. Lamkin, president of the association, states, however, that the announcement of the names of the ten members of the committee will not be forthcoming before Sept. 15. Although the National Educational Association has announced that persons will not be chosen to compose this committee who are known to be hostile to the utilities, it has been learned that the names of several educators have been rejected because of points of contact, even remote, with utility men or associations. Apparently this committee will be made up of those engaged in educational work exclusively.

Officials of the National Educational Association say that the committee will be instructed to view the utilities as only one of their problems, as far as the distribution of publicity material is concerned. It also is pointed out that the committee will not concern itself greatly with the situation regarding the cooperation between colleges and industrial engineers in planning various courses. In general, the introduction of publicity material in the schools will be considered from two angles. One point of view will be applied to the situation concerning primary schools. Another procedure will be applied to the secondary schools, where it is realized that the students are less dependent mentally.

Transmission, Carrier Current, Lightning

Grouped Papers Dealing with Problems Offered by These Subjects Conclude Valuable Program of Pacific Coast A.I.E.E. in Spokane

TECHNICAL sessions on Thursday and Friday, Aug. 30 and 31, crowded with papers that held the attention of the 250 members and guests who gathered in Spokane last week for the Pacific Coast convention of the American Institute of Electrical Engineers, brought to a close a constructive and well-arranged program. The first two days' sessions were reported last week. One of the most valuable papers presented on Thursday was on the movement of overhead-line conductors during short circuits. It was by W. S. Peterson and H. J. McCracken, Jr. The paper gave the results of a comprehensive series of tests conducted by the Los Angeles Bureau of Power and Light and showed that the great distances through which conductors move under heavy short-circuit conditions have introduced a very important factor which must be taken into consideration in future line design. More than three hundred field tests were made in all, and by a unique photographic method the actual path of conductor movement was recorded on photographic film.

Discussion brought out the fact that many utility companies have experienced trouble from conductors swinging together and burning down at the time of short circuits. As pointed out by the authors and several who discussed the paper, the more obvious remedies are greater spacing, increased tension or shorter spans. One operating company reported the successful use of strain insulators to chain conductors together in the center of long spans to reduce the effective span length to one-half.

Operating engineers welcomed the method proposed in a paper by E. A. Loew for determining the most economical line voltage and conductor size for transmitting any given load over a line of any given length. The paper included a set of calculated curves which should eliminate much of the uncertainty of trial-and-error methods.

Curves produced from laboratory tests on a single line made to simulate many different lines were given in a paper by H. V. Carpenter. From the experiments performance curves were produced for lines up to 300 kv. and 650 miles in length under various loadings. Discussion showed the value of such experiments in determining transmission-line performance under any assumed conditions.

A discussion of the general problem of residuals in power systems was presented by L. J. Corbett, and oscillograms were given to support the theory advanced. The author had found the use of supplementary Y-delta transformer banks effective in reducing residuals arising from Y-Y banks where no tertiary had been provided. Discussion stressed the importance of bearing in mind that an increase of as little as 10 per cent in impressed voltage will increase exciting current by 100 per cent in some cases and hence greatly increase the harmonics which give rise to residuals.

Friday morning was given over to three papers dealing with various phases and problems of carrier-current telephone communication. Dr. L. F. Fuller and W. A. Tolson discussed various systems of carrier communication and types of equipment suitable to meet the economic requirements of a given situation. The successful application of single side-band, suppressed, carrier telephonic communication to the 220-kv. Pit River lines of the Pacific Gas & Electric Company was described in a paper by W. V. Wolfe and J. D. Sarros. Carrier telephone systems for short toll circuits were the subject of a paper by H. S. Black, M. L. Almquist and L. M. Ilgenfritz.

The paper by Messrs. Wolfe and Sarros was the subject of considerable discussion. J. P. Jollyman said that the equipment described in the paper had been in service several months and had given very satisfactory service. The quality of voice is good, switching has caused no trouble, and wire-line extensions up to 70 miles in length have been used successfully. R. Wilkins said that the line modulation effect produced by corona around the transmission conductors which had been encountered and which gave rise to the adoption of the single side-band, suppressed, carrier system was a subject that is little understood and needs further study. The problem of applying carrier communication to this particular line was unusually difficult owing to the excessive noise encountered. The authors of the paper attributed this to the line-modulating

effect mentioned, but several who discussed the paper disagreed with this theory, maintaining that corona was not responsible for the high noise level, but rather that the particular type of corona shield used on the line gave rise to static discharges and hence noise, and that there was nothing inherent in 220-kv. lines that makes the problem fundamentally different from carrier application to lines of lower voltage. The opinion was expressed also that the use of condenser coupling instead of antenna coupling was largely responsible for the reduction in noise and that there was no necessity to depart from the standard carrier systems heretofore used. Mr. Sarros said that it was not the endeavor to develop a new system but simply to apply established good practice in carrier communication over long-distance telephone lines.

In a paper on lightning arrester practice A. L. Atherton made a plea for co-ordination of effort by manufacturers, operators and universities in the solution of the lightning problem, to the end that it may be solved in a much shorter time and at much less expense to the industry. The thermal dissociation theory of the formation of conducting paths from charged clouds to earth during thunderstorms was covered in a paper by M. A. Lissman. Papers on heat flow from underground cables, by N. P. Bailey, and on cable-sheath corrosion in creosoted wooden duct, by R. M. Burns and B. A. Freed, were valuable from the standpoint of the operating engineer.

Inspection trips on Saturday took many to points of interest in and around Spokane. The next Pacific Coast convention will be held under the auspices of the Los Angeles Section in the latter part of August, 1929.

Kentucky Hydro-Electric's Unique Station Ready

The unique generating station of the Kentucky Hydro-Electric Company which was illustrated in an ELECTRICAL WORLD frontispiece printed March 10 last has just been completed. This station, operating under supervisory remote control from a switchboard three miles away, is rated at 2,500 hp. and is on the Kentucky River at the government lock and dam No. 7, three-fifths of a mile below High Bridge. Construction of the building, arrangement of generating units and automatic operation controlled from a distant point are the fruits of the most unusual engineering feat ever attempted by the company.

The entire station has been built out over the locks, using hollow upright piers especially constructed for support. The generators and automatic switchboards are installed in the generating room above, with shafts running down through the hollow piers which support the building to the waterwheels below. A manhole in the floor of the generating room provides convenient access to the generator shafts and waterwheels. Elimination of attendants is made possible by the installation of elaborate automatic switchboards which receive their operating impulses from an especially constructed switching station at the Dix River Dam hydro-electric station, which has a capacity of 30,000 hp.

There are three generators installed in the new plant, each rated at 680 kw., 80 per cent power factor. Governors are placed beside each generator, while on the back wall of the room the intricate controlling switch mechanism is built. A substation has been built on the bank of the river beside the plant. Transmission lines have been erected up the side of a steep cliff and carried across country to Harrodsburg. Twenty-two farms have already been connected to this line.

Atlanta Power Conference of Importance to South

Means of fully utilizing the South's water-power resources to provide for the growing demands of both industry and agriculture will be one of the most important topics to come before the fourth meeting of the Southern Appalachian Power Conference in Atlanta on Oct. 8, 9 and 10, which, it is predicted may prove one of the most important industrial conferences ever held in the South. Some of the best qualified men in the country will lead the discussions, and it is expected that considerable headway will be gained toward solving the South's power problem.

The economic value of interconnecting power lines for efficient distribution of electricity throughout the South, the matter of power rates, power legislation, forestry conservation as an aid in the preservation of water powers and river surveys will be among the specific topics. Among those who are expected to take part are William E. Humphrey, chairman of the Federal Trade Commission; P. S. Arkwright, president of the National Electric Light Association; General Edgar Jadwin, chief of engineers, U. S. A.; Wilbur A. Nelson, state geologist of Virginia; Warren King of the United States Geological Survey, and N. M. Argabrite, vice-president of the American Gas & Electric Company. Rural electrification will be discussed by Governor L. G. Hardman of Georgia; Dr. Andrew M. Soule, president of the Georgia Agricultural College; C. W. Appleton, vice-president of the General Electric Company; E. J. Sanderson, of James Leffel & Company; Dr. Harrison E. Howe, editor of *Industrial and Engineering Chemistry*, and Dr. Bradford Knapp, president of the Alabama Polytechnic Institute.

The Southern Appalachian Power Conference is headed by Dr. Andrew M. Soule, president of the Georgia Agricultural College. L. O. Crosby, president of the Mississippi State Development Board, is vice-president; E. Y. Chapin, president of the American Trust & Banking Company of Chattanooga, is treasurer, and Wilbur A. Nelson, state geologist of Virginia, is secretary. Its first meeting was held in Asheville, N. C., in 1922, at the call of several Southern governors and state geologists, and the third meeting in Chattanooga last October.

Work to Begin on High-Head Plant in Upper New York

Awarding of contracts totaling $328,280 by the Lamoka Power Corporation for construction of a six-mile canal between Lake Lamoka and Little Lake, N. Y., has set in motion ten-year-old plans for a hydro-electric development whereby it is proposed to utilize waste waters of the region twice under a total available head of 400 ft. These plans in their earlier form have been previously reported in the ELECTRICAL WORLD.

According to the present announcement, the canal, the first of five development stages, will be built by the Dutcher Construction Company. The project will take advantage of waters of the two lakes and the Cohocton River and utilize Seneca and Keuka Lakes as outlets and for the second stage of power development. Controlling stock of the Lamoka Power Corporation is divided equally between the E. L. Phillips interests and G. R. and C. W. Mills of Sodus, president and vice-president of the Lamoka company.

When the enterprise is completed, a lake 14 miles long will spill its waste waters 400 ft. into Keuka Lake, near Penn Yan, and a canal will provide outlet for another 265-ft. fall from Lake Keuka to Lake Seneca at Dresden. Power houses will be constructed at both points. The entire village of Sonora, on the upper level, will disappear under the reservoir.

Pending completion of the project, generating machinery producing 2,500 kw. will be installed at the base of the penstocks between Lamoka and Keuka. When the full development has been completed, the power unit will be used as an exciter for the 20,000-hp. plant at Lake Keuka. The Lake Seneca plant also will develop 20,000 hp. Plans also are under consideration to save approximately 60 per cent of wastage in waters spilling over the dams outside of peak hours by pumping water from Lake Keuka back into the upper basin for use during heavy demands.

Plans for the project took shape in 1918 when the New York State Legislature passed a special act authorizing the Lamoka Power Corporation to use the floodwaters of the Cohocton River and Little and Lamoka Lakes. Power of eminent domain was granted. Construction of the project will assure the state of New York free opportunity to maintain the level of the Barge Canal, for which the corporation will be compensated by use of water. The first power unit will be installed in the Lake Keuka plant by the New York Central Electric Corporation. The Lamoka Power Corporation will remain a business corporation to sell water only. The project, when complete, also will act as a stabilizer of levels in all three lakes.

Briefer News

PROGRESS OF CONSTRUCTION IN OKLAHOMA. — The new 30,000-kw. turbo-generator at the Horse Shoe Lake plant of the Oklahoma Gas & Electric Company in Harrah is ready. Erection of two new boilers is also going forward, and these units will be in service in October and November respectively.

KANSAS CITY AGREEMENT ENJOINED. —A temporary restraining order issued late last week at Topeka by the Kansas Supreme Court has for the present restrained Kansas City (Kan.) city officials from entering into the contract with the Kansas City Power & Light Company referred to in the ELECTRICAL WORLD for Aug. 18, page 327, and last week, page 428.

NEW 70-MILE LINE IN WYOMING.—The Mountain States Power Company announces that it will build a 70-mile transmission line from Lovell to Greybull, Basin, Manderson and Worland, Wyo., connection being made with its power plant at Shoshone Dam near Cody, Wyo. This will carry the line through the Big Horn basin, where there are many oil fields and many residents eager for the service. The estimated cost is $150,000.

MUNCIE-ANDERSON LINE IN INDIANA WILL HELP MUNICIPAL PLANT.—O. M. Drischel, superintendent of the Indiana General Service Company at Anderson, Ind., has announced that a contract for constructing a high-tension line from Muncie to the edge of Anderson (about 20 miles) for standby service had been awarded to the Hoosier Engineering Company at $18,000 a mile. A substation will be built near Anderson and the power will augment the city municipal service in case of necessity.

WORK ON SECOND UNIT OF POWERTON (ILL.) PLANT BEGINS.—Work was started on Aug. 15 on the installation of the second unit in the plant of the Super-Power Company of Illinois at Powerton, near Peoria. The new turbine will be of the same capacity as the first one, now approaching completion — 52,500 kw. They will serve four Insull companies—the Commonwealth Edison, Public Service of Northern Illinois, Illinois Power & Light and Central Illinois Public Service.

WHOLESALE SERVICE IN OREGON.—Wholesaling electrical energy in Oregon is becoming an important factor in the development of major light and power industries in that state, according to Public Service Commission records, especially in the southern part of the commonwealth. The Mountain States Power Company, with headquarters in Albany; the California-Oregon Power Company, with headquarters at Medford; the Eastern Oregon Light & Power Company and the Idaho Power Company are among utilities doing a wholesale business and supplying irrigation projects, municipal distribution plants and other companies, and a great expansion of such wholesale service is expected.

EMPIRE DISTRICT ELECTRIC TO ENLARGE TRANSMISSION SYSTEM IN MISSOURI.—The Electric Utilities Company, allied with the Empire District Electric Company, Joplin, Mo., plans to build 33 miles of 60,000-volt transmission line to serve twenty towns in the vicinity of Marshfield and north and east of Springfield. The new line will supply power to the Missouri Electric Power Company, tying in with its Marshfield system.

FIFTEEN-MILE FALLS PROJECT AUTHORIZED.—Permission to carry out its plans for hydroelectric development at Fifteen-Mile Falls in the Connecticut River has been granted by the New Hampshire Public Service Commission to the Grafton Power Company, a subsidiary of the New England Power Association. This project has been described in the ELECTRICAL WORLD. Two dams 160 ft. in height and storage capacity for 5,000,000,000 cu.ft. of water are part of it. Ultimate capacity will be 200,000 hp. and ultimate cost $40,000,000. The generating units will be within the jurisdiction of New Hampshire, and the total energy planned exceeds the present total of all the public utilities in the state. The commission stipulates that all reasonable demands from New Hampshire must be met before any power is exported. Active construction began this week at the Fifteen-Mile site on the first 82,500-hp. installation.

RAPID PROGRESS ON NEW BUFFALO UNIT.—Work on the 75,000-kw. addition to the Charles R. Huntley station of the Buffalo General Electric Company is progressing rapidly. The stator has been set on its foundation, and the turbine is being tested at the factory. The 83,333-kva. transformer is on the way. This transformer is 19 ft. in height and weighs 114 tons, being among the largest of its type.

ANOTHER CALIFORNIA RATE REDUCTION. — Substantial rate reductions amounting to approximately $170,000 annually will be voluntarily placed in effect on Sept. 9 by the Southern Sierras Power Company, according to schedules filed by the company with the California Railroad Commission. The reductions will affect lighting charges by $82,000 annually, heating and cooking charges by $23,000, agricultural power by $41,000, and industrial power (Imperial Valley) by $24,000.

FIRST PURELY RURAL ELECTRIC COMPANY IN INDIANA.—Approval has been given by the Indiana Public Service Commission to Everett M. Hurst to construct electric distribution lines and to operate a rural light and power com-

Floodlighting Device That Resembles Street Lamp

WITH the "Duo Lux" floodlighting system of the Westinghouse Electric & Manufacturing Company each projector is concealed in an ornamental lantern and when mounted on a lighting standard presents the appearance of an ordinary street lamp. The halftone shows the side of the auditorium on the Million-Dollar Pier at Atlantic City. These units are rated at 1,200 watts.

In the illumination of the wall, which is reflected on the runway to the ocean end of the pier, eleven Westinghouse units are used in connection with three floodlighting projectors. The units consist of ornamental lanterns with glass canopies, each equipped with two lamps —one in the canopy burning base up and one in the body of the lantern burning base down. This permits floodlighting and thoroughfare illumination from a single unit and standard and in an unusually attractive manner.

pany in Decatur and Bartholomew Counties. Rates set in the order are not to be made effective except on approval by the municipalities in which the company will operate. No money is to be collected for building the line until the actual work has been completed and approved by the commission. This order was the first of its kind in Indiana.

SWITCHING STATIONS TO TIE IN CANADIAN PLANTS.—Plans are being made by the Gatineau Power Company for the construction of a switching station at Val Tetreau, Quebec, to cost approximately $100,000. The new switching station will tie the Chelsea and Farmers' Rapids plants on the Gatineau River with the Chaudière and Bryson plants and is intended to reduce the possibilities of service interruptions.

DES MOINES PROTESTS AGAINST CUT IN STREET-LIGHTING RATES.—A new city lighting rate for Des Moines, Iowa, proposed by Mayor MacVicar will be resisted by the Des Moines Electric Light Company as non-remunerative and confiscatory. The company, its officers point out, has made two reductions voluntarily within the last two years, the first of $5,000 annually and the second amounting to $16,000, in addition to a retail business lighting cut on June 15 which reduced the bills of three thousand firms about $27,000 a year.

START MADE ON GOVERNMENT ELECTRIC SYSTEM FOR SASKATCHEWAN. — A start is being made by the government of Saskatchewan, Canada, in working out the recommendation of the Saskatchewan Power Commission favoring central control and operation of the production and distribution of electrical energy in that province. A committee from the Cabinet was to visit Saskatoon to examine into the immediate power requirements of that city. As previously reported, the Saskatchewan Power Commission on July 21 unequivocally reported in favor of government ownership and operation in Saskatchewan and recommended the immediate purchase of the municipal plants at Regina, Moose Jaw and Saskatoon as the initial step.

GENERATING PROJECTS FOR CAPE BRETON.—The city authorities of Sydney, Nova Scotia, have asked the Dominion Coal Company to submit figures for supplying Sydney with electric light, heat and power from a large power plant which the company contemplates constructing in the near future near Sydney to generate the whole or part of its own southern colliery power requirements, which total about 100,000,000 kw.-hr. a year. The plant will burn powdered coal and will have the double-barreled object of providing steam power as cheap or cheaper than hydro and improving the colliery employment situation by providing a new outlet for certain types of coal. It is also learned that the Cape Breton provisional power board, organized by the various towns on the island, has been making progress in the investigation of the Lake Ainslie hydro-electric power project and of the cost of producing power at the coal mines.

GREAT LAKES, N.E.L.A., CONVENTION TO BE HELD Sept. 27-29.—French Lick, Ind., will again be the meeting place of the Great Lakes Division of the N.E.L.A. when it assembles for its eighth annual convention on Sept. 27-29. Among those on the program are President Arkwright, Section Chairmen Owens and Sampsell, Executive Manager Clapp and Miss Eloise Davidson of the national body; President J. E. Johnson of the Great Lakes Division, E. L. Hinchcliff and Dempster MacMurphy of the Middle West Utilities Company, J. F. Gallagher of the Michigan State College department of agricultural engineering, Arthur Perrow, chief accountant Illinois Bell Telephone Company, and Mrs. Anna S. Richardson of the *Woman's Home Companion*.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see issue for July 7, page 48.]

Western Section, International Association of Electrical Inspectors—Cosmopolitan Hotel, Denver, Sept. 10-12. W. S. Boyd, 175 West Jackson Blvd., Chicago.

Society for Electrical Development—Annual meeting, New York, Sept. 14. J. Smieton, Jr., 420 Lexington Ave., New York.

Illuminating Engineering Society—King Edward Hotel, Toronto, Can., Sept. 17-20. L. H. Graves, 29 West 39th St., New York.

Rocky Mountain District, N.E.L.A.—Hotel Colorado, Glenwood Springs, Sept. 17-20. (With Colorado Utilities Association.) O. A. Weller, Public Service Co. of Colorado, Denver.

Empire State Gas and Electric Association—Saranac Inn, Upper Saranac, N. Y., Sept. 20-21. C. H. B. Chapin, Grand Central Terminal, New York.

American Electrochemical Society—Hotel Kanawha, Charleston, W. Va., Sept. 20-22. C. G. Fink, Columbia University, New York.

American Electric Railway Association—Cleveland, Sept. 22-28. J. W. Welsh, 292 Madison Avenue, New York.

International Committee on Illumination, Saranac Inn, Lake Saranac, N. Y.—Sept. 22-28. (See Illuminating Engineering Society.)

New England Section, N.E.L.A.—Poland Springs House, South Poland Springs, Me., Sept. 24-27. Miss O. A. Bursiel, Statler Bldg., Boston.

Great Lakes Section, N.E.L.A.—French Lick Springs, Ind., Sept. 27-29. R. V. Prather, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

American Society of Mechanical Engineers—Boston, Oct. 1-3. C. W. Rice, 29 West 39th St., New York.

Association of Edison Illuminating Companies—Chamberlin-Vanderbilt Hotel, Old Point Comfort, Va., Oct. 1 to 5. P. S. Millar, East End Ave. and 80th St., New York.

National Safety Council—Hotel Pennsylvania, New York, Oct. 2-5. W. H. Cameron, 108 East Ohio Street, Chicago.

Southern Appalachian Power Conference—Atlanta, Oct. 8-10. W. A. Nelson, Charlottesville, Va.

American Welding Society—Philadelphia, Oct. 8-13. M. M. Kelly, 33 West 39th St., New York.

Eastern Association of Electrical Inspectors—Municipal Bldg., Springfield, Mass., Oct. 10-11. R. Walker, 85 John St., New York.

Kansas Section, N.E.L.A. — Wichita, Kan., Oct. 18-19. H. Lee Jones, 401 National Reserve Bldg., Topeka.

International Association of Municipal Electricians—Hotel Montelson, New Orleans, Oct. 22-26. H. N. Lang, Box 1864, Orlando, Fla.

Public Utilities Association of West Virginia—Hotel Pritchard, Huntington, Oct. 24-25. A Bliss McCrum, 514 Charleston National Bank Bldg., Charleston.

American Institute of Electrical Engineers — Regional meeting, Atlanta, Oct. 29-31. F. L. Hutchinson, 33 West 39th St., New York.

National Electrical Manufacturers' Association—Briarcliff Lodge, Briarcliff, N. Y., Oct. 29-Nov. 1. S. N. Clarkson, 420 Lexington Ave., New York.

HIGH BRIDGE STATION, ST. PAUL, TO HAVE NEW 35,000-KW. UNIT NOV. 1.—Installation of a 35,000-kw. steam-electric turbo-generator at the High Bridge station of the Northern State Power Company, St. Paul, to replace the unit damaged early in January, will begin at an early date, according to H. W. Fuller, vice-president Byllesby Engineering & Management Corporation. Shipment is about to be made from the factory, and it is expected that the turbine will be ready for service by Nov. 1. Completion of the 21,600-kw. Chippewa Falls hydro-electric station of the company in Wisconsin approximately two months ahead of the scheduled date has provided sufficient power to meet the system demand until the St. Paul unit is ready for service, which will be in advance of the heavy winter peak.

WHAT THE DESCHUTES RIVER MEANS TO OREGON. — An argument signed by civic bodies and individuals throughout Oregon and aimed at the four initiated bills forbidding development of the Deschutes and other rivers appears in the official voters' pamphlet now issued. It points out that the Deschutes River, the foremost water power-stream in the state with the exception of the Columbia, contains at eighteen sites 425,000 potential horsepower which can be developed at a reasonably low cost without storage and that a large part of this power would be transmitted to Portland and other cities in the Willamette Valley. "Look these facts in the face," says the argument: "Oregon is importing now from California, Washington and Idaho more hydro-electric power than Oregon is producing, and Oregon is losing right along to Tacoma big industrial enterprises Oregon would get if she could meet Tacoma power rates. Tacoma has no source of power as cheap or as big as the Deschutes River affords."

TEXAS GRANTS POWER-GENERATING RIGHTS ON RIO GRANDE FOR FIRST TIME.—An application of the Maverick County Water Improvement District No. 1 of Eagle Pass, Tex., to divert water from the Rio Grande for generating electric power has been granted by the State Board of Water Engineers over the protest of irrigation district

authorities of the Lower Rio Grande Valley. It is the first application to be granted for use of the water of the international boundary stream for hydro-electric purposes, and it is expected that it will establish a precedent for other projects of the same kind. A permit was some time ago granted to District No. 1 to divert 600 sec.-ft. from the Rio Grande for irrigation purposes. The new permit allows the diverting of 1,500 sec.-ft., which will not only supply irrigation needs but also those of the proposed 10,000-hp. hydro-electric plant. The flow in the canal from the intake to the point where the water is returned to the river will be by gravity, and it is said that only a minimum loss of water will result from its use. Opposition to the grant was based on the ground that it would complicate the adjudication of the Rio Grande water rights as between the United States and Mexico.

PUBLIC SERVICE OF NEW JERSEY MOVES NEW TRANSFORMERS UP WEST ORANGE MOUNTAIN.—One of the heaviest tasks ever attempted in transporting machinery was undertaken last week when the Public Service Electric & Gas Company of New Jersey started to move seven transformers weighing 72 tons each up the mountain in West Orange, N. J., on the top of which the company is constructing a new switching station. The avenue up which the transformers are being carried upon specially built vehicles is one of the steepest roads of its length in the country, having a 12 per cent grade. A bond of $100,000 insuring the county against damage to the highway had to be posted. The vehicles used consist of an especially constructed 100-ton trailer, hauled by a chain of four 5-ton trucks, supplemented by a tractor. These will be anchored to the road during the journey. Engineers for the company estimated that it would take two days to ship one transformer over the one-mile route up the mountainside and about three weeks to complete the shipment.

EMPIRE STATE ASSOCIATION'S PLANS FOR SEPTEMBER CONVENTION.—The program for the twenty-fourth annual convention of the Empire State Gas and Electric Association, to be held at Upper Saranac, N. Y., on Sept. 20-21, includes addresses by three well-known men not connected with the industry. Prof. W. I. Myers of the New York State College of Agriculture will discuss the agricultural situation in New York, State Senator J. Griswold Webb will talk on "Airways and Airports," and Dr. L. A. Wilson, Assistant Commissioner of Education, will deal with New York State's industrial needs. On Thursday the president of the association and the accident prevention, accounting, commercial and public utility information chairmen will be heard from, and on Friday the chairmen of the electric, electric meter, gas and women's sections and of the committee on public speaking. President P. S. Arkwright of the N.E.L.A. will address the Friday morning session on the danger of attempting to operate local public utilities through long-distance management.

NEW INSTALLATIONS FOR BRITISH COLUMBIA.—Expenditure of approximately $270,000 will be undertaken by the British Columbia Electric Railway Company in the immediate future, according to estimates approved by the city officials. The major development is the enlarging of the existing substation at Point Gray. Two 6,000-kw. transformer banks and four high-tension oil circuit breakers are being installed.

Commission Rulings

RELATIONS OF A PAPER-MAKING COMPANY TO SUBSIDIARY UTILITY BUYING POWER FROM IT.—The Nekoosa-Edwards Light & Power Company of Port Edwards and Nekoosa, Wis., is a subsidiary of a paper-making company which generates the power sold by the utility. The Wisconsin Railroad Commission decided that the paper company, as a consumer of energy, might connect its main office and branch buildings to its own supply circuit and was under no obligation, under the contract with its subsidiary, to buy back from the light and power company the very energy it had generated and sold to the latter.

COMPARISON OF RATES WITH THOSE OF OTHER PLACES IN NEIGHBORHOOD NOT SOLE CRITERION.—The town of Grandview, Mo., having a population of 500, complained to the Missouri Public Service Commission that the rates for electricity of the Missouri Public Service Company were excessive because of the fact that three neighboring villages with still smaller population were served at lower rates by another company. The commission held that by law it could not accede to the principle of fixing rates simply by comparison with adjoining territories, thus wholly disregarding any consideration of the cost of service in different communities or the value of the property employed in rendering the service as well as other factors which usually receive more or less consideration in rate fixing.

ONE UTILITY DEPARTMENT CANNOT BE LEVIED ON TO PAY DEFICIT MADE BY ANOTHER.—Another decision forbidding the taxation of a profitable department of a utility company to make up the deficit incurred by another department has been made. The Northwestern Electric Company asked permission to discontinue street-railway service in the city of Meadville, Pa., on the ground that it was a losing business. Those opposing this abandonment attempted to show that the electric department of the company was being operated at a profit. The Pennsylvania Public Service Commission, however, declared: "Even if this is true it cannot affect the determination in this proceeding. Persons securing electric service from the applicant company cannot be required to bear the cost of furnishing street-railway service to the protestants."

Recent Court Decisions

VALUATION SUSTAINED AGAINST CLAIMS OF ERROR.—The Supreme Court of Ohio denied a rehearing in Hardin-Wyandot Lighting Company vs. Public Utilities Commission of Ohio, where several errors in valuation were charged. The court said that a company agreeing to the use of an appraisal in a prior case involving the "five-year-trend" rule cannot complain of a failure to value the property as of a date certain. When such a valuation resulted in a greater figure than the price on a date certain, it could not be reversed for omitting an item less than the increase. Nor was it erroneous because of the omission of an allowance for "going concern" unless the valuation was less than the value as a going concern, inasmuch as items of organization, general expenses, etc., enter into the development of a utility's property and give an added value to the physical property belonging to the company. (162 N.E. 262.)*

CONSTRUCTION OF DAM AT LOWER SITE NOT BREACH OF COVENANT RESERVING POWER TO GRANTOR OF UPPER.—Reversing the finding of the trial court in Anderson vs. Otter Tail Power Company, the Supreme Court of Minnesota held that when the power company built a dam four miles down the Otter Tail River from a certain original dam site it did not infringe a covenant bestowing 20 hp. free forever upon the plaintiff (the grantor of that original site) in the event of a new dam being built upon it, even though the building of the lower dam had now made it impracticable to erect a new dam on the upper site. (At the time of the grant a dam had stood on the upper site, but it had "gone out" or fallen into disrepair.) Granting that the defendant had committed a wrong, the Supreme Court said, damages must be based on the rights reserved by the covenant, and the event upon which this covenant was to operate in the plaintiff's favor had not occurred. (220 N.W. 404.)

LIABILITY FOR INJURY CAUSED BY MOVING A WIRE LYING ON STREET.—Addison Stearns, seeing a telegraph wire lying on the street, attempted to move it with a broom handle and, because the wire crossed a trolley line wire, was injured. He sued both the Postal Telegraph-Cable Company and the New York State Railways, but both complaints were dismissed. The New York Supreme Court, Appellate Division, sustained the dismissal as regarded the railway company, against which it held there was no evidence of negligence, but granted a new trial as against the telegraph company. The Supreme Court held that the contact between the telegraph wire and the railway system might as likely have been with the transmission wire, lack of insulation on which was not negligence, as with a defectively insulated feed wire, as alleged. In regard to the negligent installation of the telegraph wire, however, there was a question which, as well as that of contributory negligence by the plaintiff, should have been left to the determination of the jury. (230 N.Y.S. 143.)

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*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Kenney Named Vice-President of Commonwealth Power

T. A. Kenney, a vice-president and director of the Allied Power & Light Corporation, was elected a vice-president of the Commonwealth Power Company at the meeting of the board of directors held Sept. 4. He has been serving on the directorate of the company since last spring. Mr. Kenney has been identified with the Hodenpyl, Hardy interests since 1912, and at the present time, in addition to his duties with the Commonwealth Power Company and the Allied Power & Light Corporation, he is vice-president and a director of a number of other utility companies.

W. H. BLOOD, JR., vice-president of the division of construction and engineering of Stone & Webster, Inc., has returned from a two months' Mediterranean cruise. He visited several countries, including Jugoslavia, Czechoslovakia, Hungary, Austria, Germany, Italy, Holland and the Holy Land.

DAN JACKSON has been appointed a member of the Illinois Commerce Commission by Gov. Len Small. Mr. Jackson succeeds Edward H. Wright, who has resigned on account of poor health. Mr. Wright was the first negro ever to be a member of the state utility commission. His resignation took place Aug. 31, and Mr. Jackson, who is also a negro, succeeded him on Sept. 1.

B. H. GARDNER, who for the last four years has been assistant to the vice-president of the Northern Indiana Public Service Company at Hammond, Ind., has resigned in order to become director of sales and advertising of the Columbia Gas & Electric System. He will leave Hammond about Oct. 1. He has been in utility work for more than 22 years. He removed to Hammond in 1924 from Lafayette, Ind., where he was local manager for the Northern Indiana Company.

BEN R. MEYER has been elected to the board of directors of the Southern California Edison Company, filling the position made vacant by the recent resignation of William A. Brackenridge, according to a statement made by John B. Miller, chairman of the Edison board. Mr. Meyer, a native of San Francisco, has resided in Los Angeles for the past 30 years and has been closely identified with the financial history of the city. In 1908 he became associated with the late Kaspare Cohn, and in 1914 he assisted Mr. Cohn in the organization of the Union Bank & Trust Company. Mr. Meyer has been president of this bank since 1919. He was for fifteen years a director of the San Joaquin Light & Power Corporation and its associated company, the Midland Counties Public Service Corporation. For the past thirteen years he has been a director and vice-president of the Southern California Gas Company. He is on the executive committee of the Los Angeles Clearing House Association and is a director of the California Institute Associates and also of the Los Angeles Chamber of Commerce.

Cobb Heads Commonwealth Power Company

B. C. Cobb, chairman of the board of directors of the Allied Power & Light Corporation and a vice-president of the Commonwealth Power Company since its formation, was named president of the Commonwealth organization at a meeting of the board of

B. C. Cobb

directors held Sept. 4. Mr. Cobb is succeeding George E. Hardy, who was elected to the newly created office of chairman. Mr. Cobb, who as operating executive has been largely responsible for the growth of the Commonwealth Power Company, has held various positions in the management of public utility properties since 1895. He was connected with Hodenpyl, Hardy & Company, Inc., for 23 years, and when that company was consolidated last spring with the Stevens & Wood interests, to form the Allied Power & Light Corporation, he was serving as a vice-president of the company and as an operating official of many of its subsidiaries.

Mr. Cobb is a native of Boston, Mass., and was educated at the Phillips-Andover Academy, Andover, Mass. After leaving school he was employed in the engineering and maintenance-of-way department of the Pennsylvania Railroad at Grand Rapids, Mich. In the course of his career in the public utility field he has served as president and director of the Consumers Power Company of Michigan, the Northern Ohio Power & Light Company, the Central Illinois Light Company, the Illinois Power Company, the Southern Indiana Gas & Electric Company, Springfield Light, Heat & Power Company, Grand Rapids Railway Company and the Michigan Railroad Company and as vice-president and director of Hodenpyl, Hardy & Company, the Commonwealth Power Company and on the directorate of the Tennessee Electric Power Company.

HARRY B. THAYER, chairman of the board of directors of the American Telephone & Telegraph Company, has resigned from that office. At a meeting of the board an amendment to the by-laws was voted discontinuing the office of chairman. Jeremiah Smith, Jr., of Boston, was elected a director to succeed Mr. Thayer, who retires after nearly 50 years of continuous service in the Bell system.

Obituary

BASIL F. HOWARD, electrical engineer with the Mountain States Telephone & Telegraph Company, Denver, died at his home in Englewood, Colo., Aug. 21. Mr. Howard was a native of England and a member of the American Institute of Electrical Engineers. He was 63 years of age.

EDWARD HUNTER, prominent business man of Dexter, N. Y., and founder of the electric lighting company which formerly supplied Brownville, Sackets Harbor and Dexter, died in Dexter, Aug. 29, at the age of 80. Mr. Hunter some few years ago sold out his lighting interests to the Northern New York Utilities, Inc.

CHARLES EUSTIS HUBBARD, prominently identified with the development of the telephone from the days of Alexander Graham Bell, and the first clerk of the Bell Telephone Company, died recently in Antwerp, Belgium, as the result of a motor-car accident. He was born at Boston, Mass., in 1842 and for many years had been a director of the American Telephone & Telegraph Company.

M. HENRI TUDOR, whose name was known throughout the world in connection with accumulators, died May 31 at his native town of Rosport, in the Grand Duchy of Luxemburg, at the age of 69. Mr. Tudor studied at the Brussels Polytechnic and Paris University and became interested in the early 80's in the practical use of accumulators. For the last fifteen years Mr. Tudor was an invalid as a result of his work with lead.

GEORGE L. SADLER, manager of the Nashua district of the Public Service Company of New Hampshire and for many years manager of the predecessor organization, the Nashua Light, Heat & Power Company, died at his home in that city Sept. 2 after a brief illness. He was a member of the Governor's Council and a former state Senator. He was in his sixty-second year. Mr. Sadler was a native of Windsor Locks, Conn.

Financial and Statistical News

Anticipate Tight Money

Various Factors Point to Period of High Money Rates During the Remainder of the Current Year

FIGURING prominently in the recent market revival, many of the leading public utility stocks have reached levels very close to their previous high records. This is especially true in the case of certain power and light common stocks such as Pacific Gas & Electric, Standard Gas & Electric, Columbia Gas & Electric, etc. With current earning records highly satisfactory, these stocks are in a position to benefit from upward movements of the markets and are less depressed than many other groups by market reactions.

With regard to the market outlook and the current position of the money market as related to this industry, the majority of opinion seems to anticipate satisfactory conditions during the autumn. In any event, the withholding of new issues during the midsummer period has had a salutary effect. The advance in money rates is regarded as a possible disturbing influence. The current issue of the *Guaranty Survey*, published by the Guaranty Trust Company of New York, says in part:

It seems certain that a period of high-money rates will continue through the fall, and no sustained or important easing seems likely until the turn of the year. The prophecy is generally made that an average call money rate of 6½ per cent and a commercial rate of 5½ per cent may be expected. . . . The probable effect of higher money costs upon business then becomes a matter of immediate concern and importance. Some possible effects may readily be suggested such as the retarding of speculation, a reduced volume of new financing, curtailment of plans for business expansion and plant extension, fewer new investment projects, a decreased volume of installment selling, less new construction.

Customers' Dividend Voted by Hartford Electric Light

Directors of the Hartford Electric Light Company, Hartford, Conn., have voted a customers' dividend amounting to 60 per cent of the October bills and an extra dividend of 60 per cent on the amount of the stockholders' October dividend accrual. Employees of the company will also share in the distribution and will receive 60 per cent of their October earnings extra. The company announces also a reduction in power rates. The letter to customers follows in part:

The abnormally large amount of water power during the year, the increased use of electricity by our customers, the low prices paid for coal and the improved efficiency of our organization have each helped materially to improve the earnings of the company for the year to date. The directors have therefore recognized in the attached vote the three parties at interest, namely, the customers who furnish the business, the stockholders who furnish the money and the employees who do the work. It is gratifying to the board that it is able this year to declare a customers' dividend of 60 per cent instead of the lesser amount of 40 per cent declared a year ago.

The amount of the customers' dividend will be approximately $280,000. The number of customers totals 65,000. In the past four years the sums distributed in this manner total about $1,000,000. It is the first time an extra dividend has been paid from earnings to stockholders and also to employees of the company. The extra dividend to stockholders amounts to about $90,000 in the form of 12½ cents a share payable Nov. 1 to stock of record Oct. 1. The employees will divide $65,000.

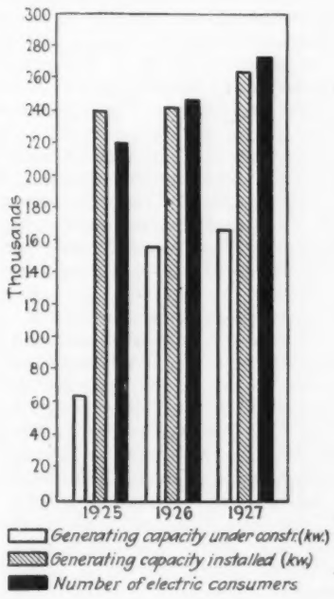
Cortelyou and Garver on Brooklyn Edison Board

In anticipation of the merger of the Consolidated Gas Company of New York and the Brooklyn Edison Company further changes have been made in the companies' boards of directors. George B. Cortelyou, president of the Consolidated Gas Company, and John A. Garver, a director, were elected members of the board of the Brooklyn Edison Company. Last week Matthew S. Sloan, president of Brooklyn Edison, was elected president of the New York Edison, a Consolidated Gas subsidiary.

Mr. Sloan has also been elected president and a director of the United Electric Light & Power Company, also a Consolidated Gas subsidiary, succeeding Nicholas F. Brady, who became chairman of the board.

National Power & Light Extends Field of Operation

HAVING gradually expanded its generating, transmission and distribution systems since its formation in 1925, by establishing interconnections between its own divisions and with the lines of foreign companies, the National Power & Light Company, according to information contained in its annual report for 1927, now serves a population of 1,415,000 in 306 communities in the States of North Carolina, South Carolina, Tennessee, Alabama and Texas. The companies controlled include the Birmingham Electric, the Carolina Power & Light, the Houston Lighting & Power, the Knoxville Power & Light, the Memphis Power & Light and the Memphis Street Railway. These figures are exclusive of the results of the acquisition early this year of the Lehigh Power Securities Corporation, the subsidiaries of which operate in an extensive area of Pennsylvania. This acquisition, incidentally, increases considerably the geographical and industrial diversification of the National Power & Light Company.



Growth of National Power & Light reflected in physical equipment and customers

Gross earnings of the subsidiaries of the National Power & Light Company controlled at the close of the year amounted to $37,067,679 for the twelve months ended Dec. 31, 1927, as compared with $33,544,895 for the similar period of 1926, an increase of 10 per cent. Net earnings totaled $14,594,915, against $13,463,453, an increase of 8 per cent. Gross earnings of the National Power & Light Company, together with the balance applicable to it from subsidiaries after deducting expenses, interest and dividends paid to the public and appropriations of $3,092,997 for renewals and replacements (depreciation), amounted to $6,424,554. After deducting from this total expenses, interest and discounts of the company, there remained a balance applicable to the payment of dividends of $5,628,254. The balance remaining after the payment of dividends on the company's preferred stock was $4,646,187. This figure is equal to $1.83 per share on the number of shares of common stock outstanding at the close of 1927, as compared with $1.75 per share for 1926 on the number of shares of common stock outstanding

at the end of that year. A segregation of the gross earnings of the operating subsidiaries shows that for the calendar year 1927 $24,641,624, or approximately 66 per cent of the gross earnings, was obtained from the electric power and light division, 23 per cent from the electric railway division, 10 per cent from manufactured gas and 1 per cent from ice and miscellaneous. Each subsidiary, excepting the Memphis Street Railway Company, reported a steady increase in gross, the Houston Lighting & Power showing the most substantial growth.

The number of consumers served totaled 351,627 during the year 1927, as compared with 320,277 in the preceding year. Of this total 271,599 were electric power and light, against 244,880 in 1926. During this same period the electric output amounted to 1,338,107,000 kw.-hr., against 1,158,156,900 kw.-hr. Last year proved to be an unusually active one in the way of physical equipment, to say nothing of the important interconnections made by the Memphis Power & Light Company and the Carolina Power & Light Company. The total installed generating capacity of the subsidiaries as of Dec. 31, 1927, was 262,943 kw., and 164,000 kw. additional capacity was under construction. Electric lines of 11,000 volts and over were increased during the year from 2,281 miles of 3,005 miles, and electric lines of less than 11,000 volts were increased from 4,064 miles to 4,548 miles. At the end of the year 193 miles of additional lines were under construction.

National Power & Light Company

	1927	1926
Gross earnings	$5,098,653	$3,819,239
Expenses	109,627	91,661
Net earnings	4,989,026	3,727,578
Interest and discounts	686,673	616,636
Net income	4,302,353	3,110,942
Dividends	3,018,719	2,433,475
Balance after dividends	1,283,634	677,467
Renewals and replacements (depreciation)	3,092,997	2,837,921
Balance from operation of subsidiaries	1,325,901	2,246,152
Combined undistributed income	2,609,535	2,923,619
Birmingham Electric Company		
Gross earnings from operations	$10,083,864	$9,472,159
Operating expense and taxes	6,651,939	6,162,123
Total income	3,438,735	3,333,577
Interest, dividends, etc.	1,308,932	1,208,024
Renewal and replacement reserve	776,730	776,730
Balance	1,353,073	1,348,823
Carolina Power & Light Company		
Gross earnings from operations	$8,928,650	$8,176,683
Operating expenses and taxes	4,802,132	4,328,976
Total income	4,711,918	4,247,562
Interest, dividends, etc.	2,618,652	2,101,078
Renewal and replacement reserve	540,000	500,000
Balance	1,553,266	1,646,484
Houston Lighting & Power Company	1927	1926
Gross earnings from operation	$6,164,017	$4,745,338
Operating expenses and taxes	3,578,204	2,683,687
Total income	2,634,148	2,093,866
Interest, dividends, etc.	993,612	822,595
Renewal and replacement reserve	777,576	625,386
Balance	862,960	645,885
Knoxville Power & Light Company		
Gross earnings from operation	$2,839,357	$2,652,490
Operating expenses and taxes	2,013,074	1,828,245
Total income	846,498	833,351
Interest, dividends, etc.	359,190	335,121
Renewal and replacement reserve	182,411	168,434
Balance	304,897	329,796
Memphis Power & Light Company		
Gross earnings from operation	$5,653,848	$5,090,869
Operating expenses and taxes	3,257,565	2,902,642
Total income	2,657,965	2,438,982
Interest, dividends, etc.	925,864	842,056
Renewal and replacement reserve	547,353	515,032
Balance	1,184,748	1,081,894
Memphis Street Railway Company		
Gross earnings from operation	$2,900,471	$2,970,069
Operating expenses and taxes	1,969,329	2,031,866
Total income	933,822	940,850
Interest, dividends, etc.	675,793	687,807
Renewal and replacement reserve	235,976	222,865
Balance	22,053	30,178

New Issues Were $66,465,000 in August

New securities of the electric light and power companies of the country offered during the month of August amounted to $66,465,000, not $85,968,000, as reported in error in the Sept. 1 issue of the ELECTRICAL WORLD. The figures contained in this article are to replace those covering utility financing in the issue referred to. August brought to a close the eight-month period with a total of $827,200,852, as compared with $943,416,700 for the similar period of 1927. The average yield amounted to 5.84 per cent, against 5.92 per cent in July.

Directors Approve Additional Issue to Stockholders

The board of directors of the Commonwealth Power Company at a meeting held Sept. 4 approved the sale of 149,551 additional shares of its common stock to common-stock holders of record Sept. 14, 1928, at $70 per share, to the extent of 10 per cent of their holdings at that date. The right to subscribe to the additional stock will expire on Oct. 5. The sale of this stock will give the company $10,468,570 in new funds. B. C. Cobb, the new president of the company, announced that the offering had been underwritten and that the proceeds of the sale would be used for corporate purposes, including the purchase of additional common stocks of subsidiary companies, thereby providing funds for additions and extensions to the system's plants and distribution facilities. The stock offering of the Commonwealth Power Corporaton marks the fifth time since 1924 that the company has raised additional capital through the offering of stock. The last previous offering was made last November, when 135,930 shares were offered at $56 each on a one-for-ten ratio.

BLACKSTONE VALLEY GAS & ELECTRIC INCREASES STOCK. — Stockholders of the Blackstone Valley Gas & Electric Company on Aug. 8 approved an increase in the authorized common stock from $7,796,200 to $11,650,000, of which $866,200 is to be issued at this time at par ($50 a share). The proceeds will be applied to the reduction of bank debt.

Alabama Power Offers Fifteen-Million-Dollar Issue

First and refunding mortgage gold bonds of the Alabama Power Company to the amount of $15,000,000 were offered during the first week of September at 99½ and interest, yielding over 5 per cent. These securities, dated Sept. 1, 1928, mature Sept. 1, 1968. The first and refunding mortgage bonds are secured by a first mortgage on important transmission and distribution properties in southern Alabama and participate in the security of the first mortgage of the former Alabama Power Company on practically all of the remainder of the physical properties owned by the company, through pledge of $37,000,000 first mortgage lien and refunding bonds, for the security of which (and of the bonds of that issue with the public) there are in turn pledged $53,552,000 of such first mortgage bonds and $1,276,000 divisional bonds. In addition, the first and refunding mortgage bonds are secured by a general lien on all the remainder of the physical properties owned by the company, subject to underlying mortgages under which $34,708,700 bonds are outstanding in the hands of the public.

The first and refunding mortgage gold bonds, 4½ per cent series, due 1967, are on the advance list dated March 30, 1928, of public utility bonds considered legal for savings bank investment under the provisions of the 1928 amendments of the banking law of the State of New York, and the company will promptly make application to the Superintendent of Banks for the listing of these 5 per cent bonds.

Canada Maintains Its Rapid Electrical Growth

Recent statistics on power consumption in Canada show that the average number of kilowatt-hours of electrical energy generated daily for Canadian use, exclusive of energy exported, during the month of May was 37,000,000, as compared with 31,000,000 in May, 1927, and 25,000,000 during the same month in 1926. The amount generated in May, 1923, was 16,000,000 kw.-hr.

Since 1923 Canadian production has increased by 129 per cent, and, using the amount generated in 1923 as a base, the yearly increase during the past five years has amounted to more than 25 per cent. This large increase in Canadian power production has taken place during the period when there was an extraordinary development going on in the newsprint industry. In 1923 newsprint production during the first six months of the year amounted to 627,000 tons, and in 1928 the total for the corresponding months was 1,164,000 tons.

Since the consumption of electrical energy by the pulp and paper industry is larger than that of any other Canadian industry, it is customary to attribute the bulk of the recent growth in power consumption to increased newsprint production. The fact that the rate

of growth in the consumption of electrical energy is much more rapid than that of the paper industry, which uses only 30 per cent of Canadian water power, shows that the index of power production is reflecting a much more general increase in power consumption than is ordinarily realized.

Central Stations in Costa Rica

Costa Rica, in Central America, has nineteen electric light and power plants with a total installed capacity of 12,438 kw., according to a list in special circular No. 572, recently issued by the Bureau of Foreign and Domestic Commerce of the Department of Commerce. Of this total, only two plants with 320 kw. are steam-driven; the rest are hydro.

Most of the plants are quite small, the two largest being at San José, 7,425 kw., and Guacimal, 2,400 kw., respectively. Alternating current prevails, usually at 110 and 220 volts, 60 cycles, three-phase.

Abitibi Power Calls Bonds

As a step in the simplification of its capital structure, the Abitibi Power & Paper Company, which controls the Spanish River Pulp & Paper Company, is taking action to eliminate the underlying Spanish River obligations. The latter company is calling for redemption of its outstanding $1,334,333 6 per cent first mortgage bonds as well as some smaller issues.

Preliminary action has been entered by a group of holders to prevent calling before due date, on account of an agreement made in 1924 by Spanish River when unable to meet interest and sinking-fund requirements on these bonds. At that time bondholders agreed on a compromise whereunder they received a tenth of all dividends to be paid on Spanish common and preferred. This bonus has averaged more than $140,000 for several years past, and as a big majority of these bonds have been retired through sinking funds and so have lost their participating rights, the bonus value has increased on the remaining issues.

The action for restraint, entered by A. C. McMaster, on behalf of New York clients, is expected to come to trial this fall.

Manhattan Electrical Supply Passes Quarterly Dividend

The regular quarterly dividend of $1.25 has been omitted by the directors of the Manhattan Electrical Supply Company. In explaining the situation to the shareholders Richard H. Brown, president, stated:

Since the issuance of these figures we have been severely criticised on account of our generous dividend policy. These critics not only stress the fact that dividends have not been earned for some time past, but that the company statement lists under assets items in which conservative accounting would dictate drastic modification. These are good will and patents, deferred development expense and unamortized bond discount and expense, which stands on the company's books in excess of $4,400,000.

Until conditions above reflected have been rectified and cash surplus position and earnings are brought to a point where renewal of dividend would be justified, the directors feel the interest of shareholders will be best served by suspending the dividend.

Since abandoning the battery business and purchasing the Troy Laundry Machinery Company, Manhattan Electrical Supply has been passing through a difficult period while the subsidiaries get into a paying stride. Troy Laundry Machinery has shown as great progress as could be expected and its July sales were 60 per cent over those for the corresponding month last year. The Halliwell-Shelton Electrical Corporation, which is engaged in the manufacture of fractional-horsepower-driven appliances, has also shown rapid progress.

Indiana Electric Corporation Completes Merger Plans

A PETITION for the proposed $70,000 merger of sixteen electric power and transportation companies in Indiana under the Indiana Electric Corporation was filed last week with the Indiana Public Service Commission. The companies, with total outstanding securties of $77,554,542, include the Central Indiana Power Company and several subsidiaries, all controlled by Samuel Insull and associates of Chicago, and the properties of the Terre Haute, Indianapolis & Eastern Traction Company.

Plans for the merger, which have been the subject of numerous conferences between stockholders of the properties involved and officials of the various companies for several months, have been completed. Although no statement was made by Frank Singleton, chairman of the Public Service Commission, as to whether a complete appraisal by the commission engineers and an audit by commission accountants will be made, he said that the commission will study the petition closely before taking final action. He assigned the case to Harvey Harmon of Princeton, a member of the commission. Mr. Harmon is away from Indianapolis and no date is set for a hearing.

Merging of the two utility groups will affect approximately 280 communities in Indiana, now served either by power or transportation companies. Halsey, Stuart & Company of Chicago are consolidation managers for the merger. This company has acted as agent for the last two years in security exchanges between the stockholders of the present companies and the promoters of the new corporation.

Financial Details of Merger

A detailed schedule of the financial status of all the involved companies, including outstanding securities, is included in the petition. This statement shows present capitalization totaling as follows: Common stock, $26,468,900; preferred stock, $15,814,500, and bonds and notes, $42,112,942. Balance issued and outstanding common stock, $19,889,400; preferred stock, $15,564,500, and bonds and notes, $42,100,542.

With reference to the refinancing under the new company, the petition provides for 100,000 shares of cumulative preferred stock of a par value of $100 each, entitled in preference to other classes of stock to cumulative dividends at 7 per cent or at such lower rate as shall be determined at the time of issue, and 100,000 shares of cumulative preferred stock of a par value of $100 each, entitled in preference to the preferred stock and the common stock to cumulative dividends at 6 per cent or at such lower rate as shall be determined at the time of issue. It also provides for 48,700 shares of preferred stock, series A and B, of which 42,200 shares shall be series A and 6,500 shares series B, of the par value of $100 each, to be entitled in preference to the adjustment preferred stock and the common stock to the cumulative dividends; 75,075 shares of adjustment preferred stock of par value of $100 each, to be entitled in preference to the common stock to noncumulative dividends beginning at 1 per cent in the second and third full years of operation of the merged corporation and thereafter increasing progressively, 1 per cent each year to 6 per cent in the eighth full year of operation and thereafter, and 2,000,000 shares of common stock without par value.

Electricity in Central America

Of Central American countries, Honduras has 22 central electric plants, British Honduras has two and Salvador nineteen, according to lists contained in special circulars No. 573 and No. 574, recently issued by the electrical equipment division of the Bureau of Foreign and Domestic Commerce. In the case of Honduras, more or less detailed information is given regarding fifteen of these plants. The installations in fourteen of them aggregate 3,710 kw., of which 85 kw. is driven by steam, 220 kw. by gas, 1,035 kw. by oil, 1,827 kw. by water power and one plant of 433 kw. by a prime mover not specified. The largest installation is one of 1,400 kw.

Several of the smaller plants generate direct current; otherwise, operation at 110 and 220 volts, 60 cycles, three-phase, predominates.

In British Honduras the only plant on which details are given is one of 375 kw., d.c., 110 and 220 volts, with gas-engine drive, at Belize.

In Salvador the list accounts for 5,075

kw., two steam plants aggregating 65 kw.; four gas, 75 kw.; one oil, 1,100 kw.; twelve hydro, 3,835 kw. Only three of these plants, totaling 65 kw., are operated on direct current. The others are almost without exception three-phase, 60-cycle installations.

Canada's June Output Increased 10 per Cent

While the output of central electric stations in Canada during the month of June was less than in the previous month, the average daily output was greater, and that of June, 1927, was exceeded by 10 per cent. The total output for the month was 1,233,922,000 kw.-hr., as against 1,271,921,000 kw.-hr. in the preceding month and 1,107,927,000 kw.-hr. in the same month of last year. Of the total production for June, 1,219,833,000 kw.-hr. was generated by water and 14,089,000 kw.-hr. by fuel.

This slight seasonal decrease in power generated by water for the month applies to all five economic areas. In Quebec the change was from 599,121,000 to 595,435,000 kw.-hr. and in Ontario from 480,126,000 to 455,305,000 kw.-hr. In the more significant comparison with the same month of 1927, however, the showing is more favorable. Last year Quebec stations produced 509,764,000 kw.-hr. in June and those of Ontario 441,493,000 kw.-hr.; in fact, production last June was the highest ever recorded for that month.

Exports are well maintained, although showing little change during the past two years except for seasonal fluctuations. For June last 127,409,000 kw.-hr. was exported, as compared with 134,830,000 kw.-hr. in the preceding month and 139,439,000 kw.-hr. in June of last year.

Italian Hydro-Electric Consumption Shows Temporary Setback*

UNLIKE preceding years, 1927, though it signalizes a perceptible progress in the development of electric plants, does not show a similar progress in the consumption of electric power. The setback is probably only temporary and due to adverse financial conditions.

At the end of 1927 about 2,700,000 kw., equivalent to 3,700,000 hp. and distributed among more than 700 central stations, had been installed in Italy. About thirty stations alone have a combined installation of more than 1,250,000 hp., thus leaving to the others an average installation of only 3,700 hp.

The power above indicated was prevailingly hydro-electric, the thermic plants, which represented 820,000 hp., constituting only 22 per cent of the total. This percentage has reference to the installed rating. Much of it is, however, generally held in reserve and used only if the output of hydro-electric power is deficient.

Several reservoirs which were building at the end of 1926 were working at the end of 1927, so that while at the end of 1926 the reservoirs in operation had a total capacity of 960,000,000 cu.m. (770,000 acre-feet), the total capacity of those in operation at the end of 1927 was no less than 1,200,000,000 cu.m. (980,000 acre-feet), which means an increase of 25 per cent. And the building of new reservoirs is still going on.

The development of transmission lines has continued. It is estimated that at the end of 1927 the total length of high-tension lines was, in round numbers, 60,000 km. (37,000 miles.)

In 1927 9,000,000,000 kw.-hr. was produced and 7,000,000,000 kw.-hr. was consumed. The difference represents the losses. As in past years there was a great difference in production and consumption among the various parts of the country, the northern being predominantly the industrial section. The proportions may be stated as follows:

Region	Production Per Cent	Consumption Per Cent
Northern Italy	75	70
Central Italy	21	22
Southern Itlay and the islands	6	8

The distribution of power was about that of former years, as follows:

	1926 Per Cent	1927 Per Cent
Light	9	12
Traction	8	9
Electrochemistry and electrometallurgy	11	11
Food industries	16	16
Textile industries	12	11
Extractive industries	2	2
Metallurgical industries	9	9
Mechanical industries	13	13
Divers industries	20	17

The table shows a large increase in consumption for electric light. There has also been a growth in the field of electric traction. In 1927 the electrification of the long line from Bardonecchia to Pisa and Leghorn was completed, and that of other important lines of the state system in the near future will contribute to the already large percentage of electrically operated railways.

The year 1927 showed a decrease in equivalent hours' use of station capacity, for whereas in 1926 these numbered 3,100, in 1927 they were less by 12 per cent.

There was little or no change in the price of electric power in 1927. It is well known that there cannot be a single fixed rate in Italy for the same company or for different companies. A distributing company cannot make the same rate for all users, because it must quote special prices to customers that can assure it a large and continuous sale of power. Likewise, the same price cannot be expected in different parts of the country, because power coming from a more costly plant must cost more, especially when the distributing company has only the one expensive plant and cannot grade down prices on account of the possession of other cheaper plants.

In 1927 the importation of coal registered a slight increase over the preceding year, a part of which is to be explained by the renewal of stocks which had been heavily reduced on account of the high prices resulting from the strike of the English coal miners. In terms of the calorific value of a single-quality bituminous coal, 15,000,000 tons was imported in 1927, as compared with 13,300,000 tons in 1926, and still smaller quantities in former years. Of these 15,000,000 tons only 3.6 per cent came from the United States; the rest came from England (44 per cent), Germany and Saar (36 per cent), and other countries (16.4 per cent). There was a similar increase in the importation of mineral oils, which rose about 17 per cent.

Abstracted from an article by E. A. Kerbaker, E.E., in the 1928 Year Book of the American Chamber of Commerce for Italy.

Massachusetts Utilities Associates

To assume control of the Massachusetts Utilities Investment Trust, the Massachusetts Utilities Associates has just been formed. The purpose of the change is to broaden the scope of the company's activities and bring about unification of the various public utility properties which it now controls through stock ownership.

Edwin H. Barker, a trustee of the organization representing New York banking interests, stated that the change of the enterprise from an investment trust, as originally planned, to a public utility holding company has been due to the rapid growth of the organization in the seventeen months of its operations.

The company's latest balance sheet, that of June 30, 1928, shows total assets of $46,967,342, the current total being slightly larger. The figure compares with the total assets of $40,950,486 reported on Dec. 31, 1927.

MISSISSIPPI VALLEY UTILITY CALLS NOTES.—All of the outstanding 6 per cent gold notes, series A, of the Mississippi Valley Power Company have been called for redemption Nov. 1 at par and interest.

MISSOURI UTILITY TO ISSUE STOCK.—The Missouri Public Service Commission on Aug. 22 authorized the Missouri Power & Light Company to issue 27,000 shares of its preferred stock and 17,000 shares of common stock. The preferred will be used to take up 7 per cent preferred stock held by the North American Light & Power Company, the new stock being 6 per cent and to be sold for not less than $100 per share. The North American Light & Power Company will purchase the common stock at $30 a share.

Business News and Market Conditions

Tight Money Major Factor in Business Situation

Analysis of reports received from the twelve Federal Reserve districts shows an unmistakable trend toward increasing soundness in all underlying economic conditions. The general industrial situation is decidedly better than was indicated by the outlook three months ago. The same is true of agriculture.

September opens, according to these reports, with production records on the up-swing in many lines of industry. Automobile output exceeds that of last year by a wide margin and the accessory manufacturers report higher volume. The steel industry is in a very satisfactory position. Unfilled tonnage of the United States Steel Corporation has shown a satisfactory increase and for July totaled 3,570,000 tons, against 3,140,000 tons for the same month last year. The textile industry stands out as an exception; activity in this field is at a low ebb.

The one uncertain factor relating to general business is the money situation. Firm money is anticipated for some time to come and business leaders have some misgivings as to the possible effect of long-continued money stringency upon trade. Recent experience has disproved the once generally held theory that cheap money is invariably a stimulus to business. But the probable effect of a condition of tight money, long maintained, is uncertain. In some fields, such as construction, there can be little doubt that it would result in the postponement of major operations, temporarily at least.

Eight of the reserve banks have increased their rediscount rates to 5 per cent and underlying factors continue to work toward firmness in the money market. While the situation outlined has not yet had any major adverse effects upon business and industry in general, the money market is being studied by business leaders more carefully than for some years.

Railroad Building Provides Electrical Business

From present indications the fall of 1928 and the spring of 1929 will long be remembered because of the heavy purchases by railroads in California.

The Southern Pacific Company is to construct a 2-mile double-tracked steel bridge across Carquinez Straits to carry double-headed overland trains. It will cost $12,000,000, of which the electrical equipment for lighting, control and auxiliary service is conservatively estimated at 1 per cent.

The Southern Pacific is also engaged upon a $2,000,000 signal service project, for which orders totaling about $50,000 have been placed during the past week. They include 1,280 miles of No. 9 iron wire, two carloads glass insulators, one carload steel pins and a carload of steel strand, for service in Arizona, the Sacramento Valley and along the Mexican extension. Six miles of lead cable have also been requisitioned by the telegraph department.

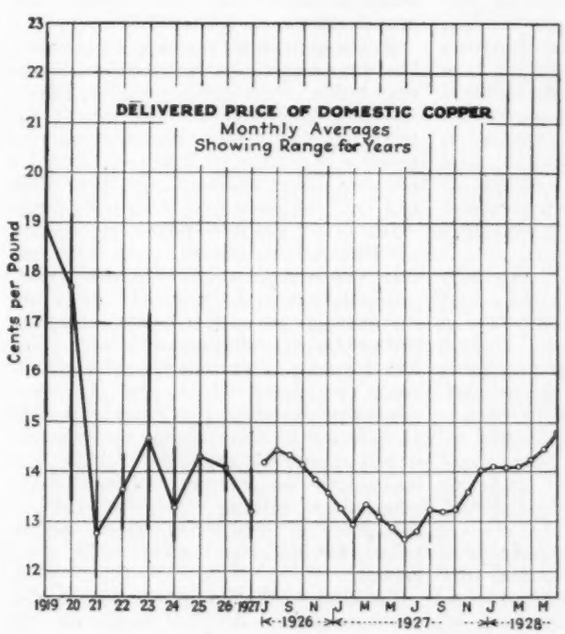
The Western Pacific has announced that its lines will be extended from Niles across San Francisco Bay to Redwood City and thence into San Francisco. The cost is estimated at $4,000,000, of which a good percentage will be allotted for electrical signaling, lighting and bridge control. The new line is primarily to expedite freight service.

The latest announcement is that the Northwestern Pacific Railroad, operating through the rich dairying and lumber country north to Eureka, has been solely acquired by the Southern Pacific through purchase of the Santa Fe's share and will be rehabilitated and possibly extended into Oregon through virgin territory along the Coast. The immediate program includes two new substations in the electrified suburban portion, totaling 1,500 hp.; the reconstruction of the 2,700-hp. San Anselmo substation and the electric conversion of the 3,000-hp. Alto steam station. The equipment is to be General Electric and orders have just been placed totaling 3,500 kw. of automatic control converters, valued at $130,000.

Copper Outlook Greatly Improved

Industry in Strong Position—European Countries Gradually Increasing Their Demand—Consumption in United States Fully Up to Expectations

THE average delivered price of copper for the first seven months of 1928 is close to 14⅜ cents, compared with 13¼ cents in 1927 and a little better than 14 cents in 1926. The industry as a whole is in much better position than a year ago, and the companies that for one reason or another enjoy the distinction of being in the low-cost class are making excellent earnings with the market at current levels. That is not to say that all companies are so fortunate, says the *Engineering and Mining Journal*, for the marginal producers still are in the picture. The monthly averages for the delivered price of domestic copper over a number of years are shown in the accompanying chart. Although there was a rapid and substantial rise of more than 2 cents in a single year, it is fair to say that the early price was altogether too low rather than that the present price is unwarrantably high.



The trend of world copper consumption is shown in another chart which illustrates graphically what may reasonably be expected in the future. The data are plotted on semi-logarithmic paper; that is to say, the vertical subdivisions are on a logarithmic scale. As a consequence it is possible by drawing a line parallel to another to represent an equal annual rate of increase, irrespective of the comparative magnitude of the quantities involved. The line *AB* is based on data from the U. S. Bureau of Mines and the Geological Survey for the apparent domestic consumption of virgin metal for various years up to 1927. The estimate for 1928 is based on domestic deliveries for the first half of the year. The war and early post-war periods are omitted for the reason that they distort the picture and are meaningless. *AB* indicates what may be called the normal trend of consumption in the United States since 1901. *CFD* is world production according to data from the American Bureau of Metal Statistics, the figure for 1928 being an estimate based on data for the first half of the year. Over

a period of years world production and consumption of course are substantially the same. A fair hypothesis is that had it not been for the incidence of the World War consumption would have increased approximately at the rate of actual increase in the United States and would have been represented by the dotted line *FG*.

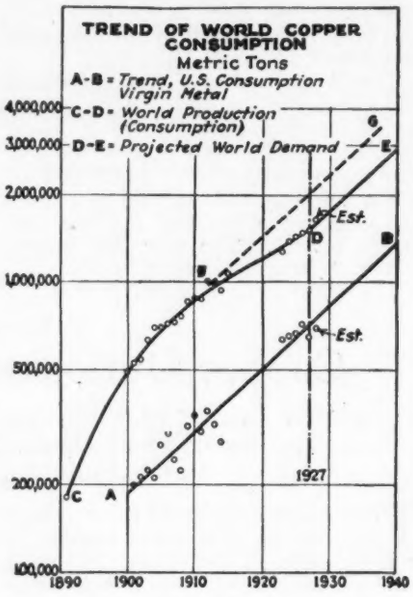
Since the war copper producers have been waiting for Europe to take its "normal" share of copper. Consumption in the United States has been fully up to expectations, and no reason is apparent for doubting that it will continue to be. The electrical industry, of course, is overwhelmingly the greatest outlet for copper—taking more than half the total. The phenomenal growth of the industry in the United States will not slacken. Automobile manufacture, telephone installation and building construction are the other single industries that take important proportions of the total consumption of copper, and with respect to these the outlook is good.

In regard to production, plenty of copper will be forthcoming in the next ten years. It is clear that consumption has been more rapid than production, broadly speaking. At the end of June refined stocks in North and South America, as well as world stocks, including blister and "in process" metal, reached the lowest level since the war. Unquestionably this has been a factor in the recent strength of the market. The relation of consumption to actual production, not to the potential production, ought to be the primary influence that affects the market price of a commodity. The reason that "potential overproduction" has played an important part in the copper market in recent years is that producers of copper allowed it to. That psychological weakness appears to have been overcome; producers now must guard against the possibility of speeding up output to an extent where instead of potential they will have actual overproduction of some volume.

High production usually has two objects: First, to cut per pound costs, and, second, to increase the number of pounds to be sold. However, a little figuring will demonstrate that a comparatively small decline in the market price of the metal may easily reduce the margin of profit on each pound to such an extent that the advantages mentioned are more than offset and net earnings are less than with a lower production rate.

Without venturing any specific predictions on the question of price, two significant points may be mentioned:

1. Important reductions in cost of production, comparable with those brought about by technical and engineering achievement in the last ten years, are not to be expected. One reason is that, instead of a margin of perhaps 30 per cent in which to improve metallurgical recoveries, there is now only about 10 per cent on which to work. A second reason is that mechanization of the process of mining and treatment has so reduced costs that there is little room for further improvement.



2. Profits are by no means excessive. Per pound earnings realized by 21 representative American companies, before charging depletion, are shown in the accompanying table. Earnings of this group amounted to 8.3 per cent and 7.8 per cent of the invested capital for 1926 and 1927, respectively. As a wide range exists in the per pound earning capacity of different companies, it is apparent that the marginal or "near-marginal" group is not to be ignored. It is not the average profits of the industry, but the profits of the companies which are less fortunately circumstanced with respect to richness of ore and other endowments of nature, that must be viewed as a factor in ascertaining the price at which copper should sell. Taking into account the one peculiar inherent characteristic of mining enterprise—the exploitation of a wasting asset—higher prices for the metal seem to be warranted.

Looking to the immediate future, the problem of the individual copper mining companies is to restrain any temptation to expand production more rapidly than the increase in demand warrants; each is getting information that enables it to gage consumptive requirements with some degree of accuracy in advance, and common sense should dictate how rapidly to increase output. By the end of 1931 consumption should be sufficient to permit existing plants to operate at full capacity.

So far as prices are concerned, the outlook is satisfactory, and with the opportunity offering for the present producing companies gradually to expand production, earnings of the mining companies should be better than they have been, by and large, since the war. The metal mining industry is rightly entitled to somewhat higher returns on its capital than most other industries, and copper mining, taken as a whole, has not enjoyed this advantage since 1920.

Electric Range Plug Receptacle Now Available

On the urgent recommendation of the technical committee of the range section of the National Electrical Manufacturers' Association to the wiring device manufacturers to standardize a heavy-duty wall receptacle and plug which would be suitable for connecting electric ranges two companies are now producing such a plug made according to N.E.M.A. standards. The two companies making such a plug are the Arrow Electric Company at Hartford, Conn., and the General Electric Company at Bridgeport, Conn. It is the hope of the range section that eventually all new range installations will be equipped with such a plug, while if owners can be induced to wire the kitchen for an electric range when the house is built or wired, using this recaptacle, it will be a simple matter to install a range later on.

It is expected that the use of this plug will remove considerable sales resistance by separating the installation cost from the price of the electric range. In the interests of the broad development of the range business, through added convenience, the range manufacturers will naturally promote the use of this plug among the power companies and other trade organizations. It is understood that the 1928 National Electrical Code will not have the requirement of a double-pole switch on the wall in sight of the range. Where local inspection departments insist on that feature it is to be noted that this plug will meet the requirment and at a low cost.

Per Pound Earnings of American Copper Mining Companies

In Cents, Before Charging Depletion

Company	1926	1927	Company	1926	1927	Company	1926	1927
Calumet & Arizona (*a*)	3.3	2.4	Magma	4.2	2.9	Phelps Dodge	2.4	2.0
Calumet & Hecla	2.9	2.3	Miami	2.1	2.2	Tennessee Copper	8.3	3.7
Chile	6.5	5.7	Mohawk	4.8	4.8	U. V. X.	6.1	4.1
Copper Range	0.4	0.7	Mother Lode	7.3	5.8	Utah (*c*)	5.2	4.9
Granby	1.6	1.4	Nevada Consolidated	3.3	2.8	Engels	1.3	1.1
Inspiration	1.6	1.4	New Cornelia	4.5	4.3	Howe Sound	9.4	6.1
Kennecott (*b*)	5.5	5.7	Old Dominion	1.4	—	Cero de Pasco (*d*)	8.5	10.3

(*a*) New Cornelia excluded. (*b*) Utah excluded. (*c*) Nevada Con. excluded. (*d*) Depletion deducted.

Market Conditions

NEW ENGLAND states have been passing through a seasonal lull in the purchase of heavy industrial equipment and little business has been done recently in small motors. New construction and general stock materials, however, have been in active demand. In the Eastern district the tone has been better; it is anticipated that motors, control apparatus, etc., will see much greater activity in the near future. This is true particularly for heavy industrial motors. Business in marine equipment is good and sales of control apparatus heavier than usual. Meter business in this area is decidedly quiet. The Southeast reports a number of fairly large orders from power companies, including distribution and power transformers, as well as insulators and watt-hour meters. A $25,000 order for motor equipment was received from a South Carolina textile concern.

Turning to the western half of the country, orders are being received in satisfactory volume, with little radical change in the basic situation. In the Middle West business is generally ahead of last year's levels. Extension work and new construction on the part of the utilities provide possibly a larger amount of business than ordinarily. One order for piping, boiler and duct insulation reached $110,000. The St. Louis district reports a large volume of sign business and two sizable substation equipment orders. Increased activity is rumored in the Kansas oil fields.

The feature of Pacific Coast activity is the purchase of equipment by the railroads. Power company orders have also been large, especially in transformers. It is of interest that the larger lumber manufacturers in the Puget Sound district are again buying. Sales of motors to this group exceeded 100.

Heavy Copper Buying Features Metal Market

In spite of the Labor Day holiday on Monday, the total tonnage of copper sold in the week ended Wednesday was the largest of any week since the buying wave in May; prices, however, remain unchanged. Lead, and particularly zinc, on the other hand, have been quieter, following the comparative activity of the two weeks previous, and tin the last day or two has been neglected. Monthly averages for August are slightly higher than for July in the case of lead, tin, zinc, antimony and quicksilver, but lower for silver, with copper and platinum substantially unchanged.

NEW YORK METAL MARKET PRICES

	Aug 29, 1928 Cents per Pound	Sept. 5, 1928 Cents per Pound
Copper, electrolytic	14.75	14.75
Lead, Am. S. & R. price	6.40	6.40
Antimony	10.3125	10.00
Nickel, ingot	35	35
Zinc, spot	6.60	6.60
Tin, Straits	47.625	47.375
Aluminum, 99 per cent	24.30	24.30

Base copper wire price Sept. 5, 1928, 16½ cents.

Good Industrial Demand in Eastern District

The demand for industrial account continues at a satisfactory level in the Eastern district and is far outdistancing the call from central-station companies. The outlook is bright for high sales volume for motors, control apparatus and kindred equipment. A manufacturer reports an order for direct-current motor units from a Detroit automobile manufacturer to an amount of $8,000, with considerable other business in sight from this same branch of trade. The iron and steel industry is in the market for heavy industrial motors and commitments are looked for at an early date. The chemical and food product industries are active in current transactions, while the call from the textile industry shows a noticeable decline. A manufacturer of industrial motors reports August business as exceeding that for the corresponding month of a year ago. Talking-machine producers are in the market for fractional-horsepower units and sizable commitments are anticipated. There is a noticeable advance in demand from this quarter for large synchronous motors for factory service.

The call for prime movers from central-station companies is rather negligible, although the prospects for fall business are encouraging. Likewise in the case of substation equipment and line apparatus, present commitments are lagging, but inquiries show an increasing interest. A producer of line hardware reports trade as very spotty, the demand for poles having declined, although cross-arms and cross-arm equipment are faring better, primarily for repair and replacement accounts. A maker of control apparatus says that sales are increasing, with every indication of continuance. Industrial plants, including printing establishments, form the bulk of current demand and good orders are ensuing. Marine equipment business is well sustained, control apparatus constituting a feature of commitments.

A manufacturer of wire and cables reports that an appreciable advance in sales can be looked for in September. The meter business shows lagging tendencies and both sales and inquiries are decidedly slow, only minor commitments being made and large orders not being expected for another 30 days or more. Construction operations in the Eastern district include:

The New York Edison Company, New York, plans a power substation on Washington Street to cost $300,000. The Radio Corporation of America, Inc., New York, will make extensions in its transmitting station at Riverhead, L. I., to cost $250,000. The Swan-Finch Oil Company, New York, will make additions in its refining plant at Franklin, Pa., to cost $350,000. The New York Central Railroad Company, New York, is arranging an expansion program at its Mott Haven yards to cost $2,000,000. Dugan Brothers, Inc., Brooklyn, N. Y., plans a bakery at Queens Village, N. Y., to cost $450,000. Armour & Company, Chicago, plan a meat-packing plant at Jersey City, N. J., to cost $900,000. The Public Service Electric & Gas Company, Newark, N. J., has purchased property at Port Reading, near Perth Amboy, N. J., and plans a power plant.

The Lehigh Valley Railroad Company, New York, plans extensions in its yards and shops at Coxton, near Pittston, Pa., to cost $200,000. The Washington Hosiery Company, Pottstown, Pa., will soon take bids for a new mill to cost $70,000. The Atlas Powder Company, Wilmington, Del., plans a nitrate plant at Reynolds, Pa., to cost $400,000. The Carnegie Steel Company, Pittsburgh, Pa., will build a storage and distributing plant to cost $300,000. The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until Sept. 18 for electric motors and spare parts for the Mare Island and Puget Sound navy yards (Schedule 9626). The General Purchasing Officer, Panama Canal, Washington, D. C., will receive bids until Sept. 20 for electric refrigerating equipment (Panama Schedule 1900). The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until Oct. 3 for one electrically operated bridge crane for the naval air station at San Diego, Calif. (Specification 5713.)

Business Continues to Improve in Middle West

Good business continues in most sections of the Middle West. Industrial activity is noticeably good, many industries reporting sales so far this year in excess of the total amount of business transacted last year. The steel and automotive industries are prospering. Utility companies continue with their construction and extension work, with a large amount of maintenance purchasing going on. Interesting orders placed include one for piping, boiler and duct insulation valued at $110,000, one for 75 25-kva., 100 37½-kva., 60 50-kva. and 60 75-kva. distribution transformers. Jobbers' sales continue to increase. Construction projects are as follows:

The American Metal Products Company, Milwaukee, Wis., plans a rolling mill to cost $100,000. Pontiac, Mich., plans a power plant in connection with additions to the Central High School to cost $400,000. The Illinois Central Railroad Company, Chicago, will build an addition to its grain elevator at Omaha, Neb., to cost $500,000. The Trindl Corporation, Aurora, Ill., plans an addition to its automotive products plant to cost $70,000. The International Harvester Company, Chicago, plans an addition to its plant at Rock Island, Ill., to cost $85,000. The Schultz Sausage & Provision Company, Chicago, plans a packing plant to cost $100,000. The University of Illinois, Chicago, will soon take bids for a power plant to cost $800,000. The Willys-Overland Company, Toledo, Ohio, will build an addition to its plant at Weston, Ont., Canada, to cost $150,000. The De Vilbiss Manufacturing Company, Toledo, Ohio, will build an addition to its spraying

equipment manufacturing plant to cost $80,000. The Pennsylvania-Ohio Power & Light Company, Youngstown, Ohio, plans a power substation to cost $100,000. The Hughes Electric Company, Bismarck, N. D., plans a transmission line from Carson to Mobridge, S. D. The Northern Power & Light Company, Elgin, N. D., will build a transmission line from Elgin to state line. The Otter Tail Power Company, Fergus Falls, Minn., will build a transmission line to Kramer, N. D., and from Bisbee to Myrl, N. D. The Montana-Dakota Power Company, Minneapolis, Minn., plans a transmission line from Marmath to Hettinger, N. D. The Sheldon Electric Light Company, Sheldon, Iowa, plans extensions in its power plant. Sioux Falls, and Woonsocket, S. D., and La Crosse, Wis., plan ornamental lighting systems.

Wire and Pole-Line Material in Demand in Southeast

Satisfactory activities in the trade are reported for the Southeast. One central station's wire orders were for 35,000 lb. of weatherproof copper wire and solid copper wire totaling $30,300. One of the smaller power companies ordered pole-line materials amounting to $5,000, while another company placed orders for pole-line hardware totaling $4,730 and $1,200 worth of creosoted pine poles. Other interesting power company orders were for distribution and power transformers amounting to $8,950, pin-type and strain insulators totaling $7,220 and $5,700 worth of watt-hour meters. The volume of small-size orders from central stations is very satisfactory. There is a reasonable amount of activity in industrial fields, but the only industrial order of any size that was placed was for motor equipment amounting to $25,000 for a South Carolina textile plant. Construction projects are as follows:

The Albemarle-Chesapeake Corporation, West Point, Va., plans a paper mill to cost $1,500,000. The Interwoven Mills, Inc., Martinsburg, W. Va., will build an addition to its hosiery mill to cost $85,000. The Tennessee Copper & Chemical Corporation, Copperhill, Tenn., will make extensions to cost $400,000. The Golden Belt Manufacturing Company, Durham, N. C., plans an addition to its hosiery mill to cost $150,000. The Royston Spinning Mill Company, Royston, Ga., will build a textile mill to cost $100,000. Creswell, N. C., plans a municipal electric light and power system. The Pitch Pine Products, Inc., Tampa, Fla., plans a turpentine and pine-oil plant to cost $100,000. Daytona Beach, Fla., plans an ornamental lighting system.

Sign Business Good in St. Louis District

There was a small decrease in the volume of sales of stock sizes of apparatus in the St. Louis district. Builders of electrical signs report a first-class demand and several good-sized contracts were signed. The only orders worthy of mention were for two substation equipments, one for $3,500 and the other for $4,250, for a power company in the southwestern part of the district. There are rumors of an increased activity in the Kansas oil fields. A 12,000-volt transmission line has been authorized from which most of the power is to be used in drilling and pumping 200 proposed wells in proved territory. Construction projects are as follows:

The Kansas City Power & Light Company, Kansas City, Mo., plans a power substation to cost $75,000. The A. Leschen & Sons Rope Company, St. Louis, plans a power house at its local wire rope plant to cost $40,000. The Bar-Rusto Corporation, Kansas City, Mo., plans extensions in its metal-plating plant to cost $75,000. The St. Louis Air Transport & Terminal Company, St. Louis, plans an airport at East St. Louis, Ill., including a floodlighting system to cost $400,000. The Maryville Electric Light & Power Company, Maryville, Mo., plans a transmission line to Barnard Mo. The Electric Utilities Company, Joplin, Mo., plans a transmission line in the vicinity of Marshfield, Mo., about 30 miles. The Star Aircraft Company, Bartlesville, Okla., plans an airplane-manufacturing plant to cost $75,000. The Phillips Petroleum Company, Bartlesville, Okla., will build a gasoline refining plant at McCamey, Tex., to cost $400,000. The Mississippi Valley Power Company, Fort Smith, Ark., plans a transmission line from Fort Smith to Ozark, Ark., about 40 miles, and will build substations at a number of communities. The Trinity Portland Cement Company, Fort Worth, Tex., will make extensions in its mill to cost $400,000. The Gulf States Utilities Company, Beaumont, Tex., will make extensions in its substation at Jennings, La., to cost $100,000. Lewisville and Borger, Tex., plan ornamental lighting systems.

Railroad Purchasing Active on Pacific Coast

Railroad purchasing continues good on the Pacific Coast and inquiries include one carload of strand for Western Pacific, 6 miles of submarine cable for relaying the Southern Pacific communication service in the Oakland Estuary, a $5,000 assortment of motors for pumping service and $2,000 worth of street lighting and other fixtures for a railroad yard and shop. Street-lighting business includes an order for 70 single light standards, transformer and cable for San Leandro, or about $8,000 worth of material. Power company orders include $6,000 worth of voltage regulators, three carloads of 80-ft. treated poles, one carload of rigid iron conduit and weatherproof copper wire, this last being for Honolulu. Manufacturers report excellent transformer sales to power companies, one reporting an aggregate of 200. Other orders include a 50-mile telephone line for Rio Vista, with about $3,000 worth of line material, $2,000 worth of telephone line material, largely cable, for Susanville; $1,800 worth of lead cable for Stockton and $1,500 worth of wire and hardware for a small power line near Stockton.

A curtailment program practiced by larger lumber manufacturers affiliated with the West Coast Lumbermen's Association, in the Puget Sound district, has succeeded in stabilizing prices and mills have started buying. Sales of motors to this source exceeded 100, ranging from 150-hp. down, for extensions and replacements, and buying, it is believed, has just started. Lamp buying from mill and other industrial sources to care for seasonal demands is expected to start within ten days and already several substantial orders have been placed. Contracts will probably be let within the next 60 days for major construction on the second unit of the Lake Cushman hydro-electric power project for the city of Tacoma, authorizing issuance of $3,850,000 in utility bonds. Tacoma also will pay $35,000 worth of transformers and substation equipment to care for the increased power loads from industrials. The Ellensburg municipal lighting department bought a boiler for a steam plant costing about $7,000. Vancouver, Wash., has let contracts for a $30,000 street-lighting installation and systems are being planned for Pullman, Wash., and Blackfoot, Idaho. Construction projects are as follows:

The Union Oil Company, Los Angeles, will make additions in its refining plant at San Pedro, Calif., to cost $250,000. Seattle, Wash., plans a substation to cost $300,000. The Boeing Airplane Company, Seattle, Wash., plans a plant to cost $110,000. The Richfield Oil Company, Bellingham, Wash., plans an oil storage and distributing plant to cost $100,000. The Skookum Lumber Company, Tacoma, Wash., operated by the Puget Sound Lumber Company, plans a hydro-electric plant on the Skookum Chuck River, to cost $200,000. The Olympic Motor Boat Company, Seattle, Wash., plans a plant to cost $80,000. The Twin Cities Fruit Growers' Association, Lewiston, Idaho, plans a precooling and packing plant to cost $100,000. The Las Vegas Light & Power Company, Las Vegas, N. M., plans an addition to its steam-operated electric power plant to cost $75,000. Los Angeles, Monrovia, Bakersfield, North Hollywood and Oroville, Calif., Kalamath Falls, Ore., and Hoquiam, Wash., plan ornamental lighting systems.

Scheduled Materials Lead in New England Sales

Heavy industrial equipment orders were few in the New England district and seasonal inactivity in buying was reported by a number of manufacturers. General stock materials were received in good volume and have been one of the encouraging features in the movement of new construction materials. Wiring devices, small switches and meters are in brisk demand. Small-motor sales have slackened, but prospects for continued strength in the market are good. Negotiations pending are expected to be closed shortly and these include several group orders for small motors, a number of turbo-generator units and line material. Industrial electric furnaces are receiving attention and electric range sales are gaining. Merchandising has manifested a level trend and appliance sales are greater in volume to date than last year. Construction projects are as follows:

The Providence Produce Warehouse Company, Providence, R. I., plans a terminal warehouse to cost $500,000. The E. E. Hilliard Company, Inc., Buckland, Conn., plans a hydro-electric development at its local woolen mill.

Activities of the Trade

Doble Wins Patent Suit on Testing Live Insulators

Judge Schoonmaker of the United States District Court, western district of Pennsylvania, has dismissed the suit of T. F. Johnson, Jr., against the Duquesne Light Company of Pittsburgh for alleged infringement of the Johnson patent No. 1,366,078, covering the so-called buzz-stick method of testing live insulators. The Duquesne company employs the Doble Engineering Company's telephonic method of testing. The claims of the Johnson patent, the decision states, were anticipated by the Austin test stick and method of 1913 and by Borquist and Centerwall in 1915. Mr. Johnson announces that he will appeal the case.

Kaestner & Hecht Company Acquired by Westinghouse

The Kaestner & Hecht Company will now be known as the Westinghouse Electric Elevator Company and the headquarters and plant will be located in Chicago. In 1926 the Westinghouse company secured a controlling interest in the Kaestner & Hecht Company and considerably extended the scope of the business. District sales offices and service shops are already established in principal cities and more will be opened in the near future. The company will operate as a separate unit of the Westinghouse company.

The officers of the new company are: E. M. Herr, chairman of the board of directors; F. A. Merrick, president; R. I. Phillips, vice-president and general manager; E. D. Kilburn, vice-president; W. S. Rugg, vice-president; N. G. Symonds, secretary; F. E. Craig, general auditor; H. F. Baetz, treasurer, and Frank C. Reed, general sales manager. Some recent contracts awarded the company for installation are the Grant Building, the Koppers Building, the William Penn Hotel and the Keystone Athletic Club, all in Pittsburgh; the Fountain Square Building in Cincinnati and the Northern Life Building in Seattle.

Graybar Develops New Radio Distribution Plan

A new national system of dealer franchises, involving allocation of exclusive sales rights for Graybar radio receiving sets to approximately 3,000 dealers in the United States, was made known by George E. Cullinan, vice-president and general sales manager of the Graybar Electric Company, sales subsidiary of the Western Electric, at the conclusion of a week's session of the company's merchandise managers held at the Sea View Golf Club, Absecon, N. J. The conference, said to be the most important held by the Graybar company since it changed its name from Western Electric Supply Department in 1925, effects a distributing reorganization applied to all resale products sold through dealers supplied by the company's seventy distributing houses.

The new dealer plan for Graybar receivers will create, according to Mr. Cullinan, a merchandising system affording the maximum in service and delivery to the customer. Under the plan, the appointment of radio receiver dealers will be made on a purely territorial basis, with each dealer fully protected under the national system of wholesale distributing houses maintained by the company. At the meeting the appointment of merchandising managers at each of the twenty main houses of the company was also announced. Each of the new managers will have under his control the supervision and direction of all resale or merchandising items. He in turn will appoint specialists in each of these items, whose sole duty it will be to sell the dealer the product concerned.

The entire plan, as outlined at the conference, is said to be the most important step ever made in this country in the distribution of electrical resale items. More than fifty Graybar sales distributing managers located in all parts of the country, as well as executives from the general offices of the company at New York, attended the meeting.

THE MONITOR CONTROLLER COMPANY, Baltimore, manufacturer of automatic controllers and electrical resistors, announces the appointment of Charles F. Goodwin as its New York district manager with headquarters at 30 Church Street. Mr. Goodwin will succeed Joseph F. Frese, who is now vice-president of the company.

New Equipment Available

Safety Saw Frame

The "Euco" safety saw frame, made entirely of insulating material, has been placed on the market by the Engineering Products Corporation, 25 Church Street, New York. The saw frame is designed for electrical work and especially for cutting cables in manholes while the cable is alive. The frame is made of wood—ash is commonly used—and is treated with a special filling and insulating hard varnish. The back of the saw frame is so proportioned as to prevent breaking of the blade when cutting flexible material. The far end of the frame is so designed as to prevent the saw running over onto adjacent cables or other metal parts. No metal parts are exposed on the outside of the frame. The wood frame overhangs at both ends so as to give further protection when cutting live conductors near adjacent grounded parts.

RESISTOR FOR ELECTRIC RAILWAY SERVICE.—A new light-weight resistor for use in the railway field has recently been developed by the Westinghouse Electric & Manufacturing Company. These type M resistors are built of tubular units, each having a steel center support insulated by sections of porcelain. About this porcelain a resistance ribbon is wound edgewise in helical form. The tubular units are mounted on insulated tie rods supported on a steel strap frame. The resistance element is an alloy on which moisture and atmospheric conditions have little effect. The temperature coefficient is negligible, thus making the resistance practically constant at all times. Localized heating is eliminated through the construction, which permits excellent radiation.

Automatic Circuit Breaker for Branch Lighting Circuits

An automatic circuit breaker, designed for use on 125-volt alternating or direct current, with ratings of 6,10 and 15 amp., is now being manufactured by the merchandise department of the General Electric Company at Bridgeport, Conn. This device was developed to control and protect branch lighting circuits, as well as small motor-driven apparatus. It combines the positive action of the electromagnet with the time lag of the thermometallic element, but does not require the thermo element to do any mechanical work. The breaker operates single-pole with a double break.

The opening of the silver contact points due to heating of the thermal element on overload causes all of the current to pass through the magnet and trips the breaker instantly. The time necessary to heat the element under the various degrees of overload constitutes the lag, which is comparable to the action of a fuse, permitting the momentary inrush of current but protecting against a continued overload. As an appliance switch it can be mounted in any position, has no exposed metal, functions equally well on alternating or direct current and will withstand severe vibration without opening. The sliding contacts tend to maintain clean surfaces. The floating contact spreader assures even, level bearing and equal pressure.

Electrical Patents

Announced by U. S. Patent Office

(Issued Aug. 14, 1928)

1,680,733. ELECTRICAL SYSTEM AND APPARATUS; R. Dietze, Pankow, Berlin, Germany. App. filed Jan. 13, 1927.

1,680,739. SYNCHRONIZING DEVICE; L. F. Kennedy, Schenectady, N. Y. App. filed May 5, 1926.

1,680,748. ELECTRICALLY-HEATED DEVICE; J. L. Shroyer, Oak Park, Ill. App. filed Sept. 28, 1925.

1,680,749. ELECTRIC HEATER; J. L. Shroyer, Oak Park, Ill. App. filed Dec. 22, 1925.

1,680,754. SYNCHRONIZING DEVICE; C. C. Traver, Schenectady, N. Y. App. filed Nov. 24, 1926.

1,680,756. SYNCHRONIZING DEVICE; F. H. Winter, Schenectady, N. Y. App. filed Nov. 26, 1926.

1,680,758. SYSTEM OF DISTRIBUTION; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 11, 1925.

1,680,765. CONTROL APPARATUS; A. C. Connell, Schenectady, N. Y. App. filed Feb. 23, 1926.

1,680,771. CONTROL SYSTEM FOR ELEVATORS; L. I. Davis, New York, N. Y. App. filed March 9, 1926.

1,680,773. POWER CIRCUIT FOR ELECTRIC MACHINES; V. E. Duemler, Maplewood, and G. R. Koeln, St. Louis, Mo. App. filed Jan. 19, 1925.

1,680,783. HIGH-FREQUENCY APPARATUS; F. Gutzmann, Charlottenburg, Germany. App. filed Aug. 26, 1926.

1,680,784. CONTROL SYSTEM FOR ELEVATORS; H. L. Heart, New York, N. Y. App. filed March 9, 1926.

1,680,787. UNIVERSAL ADAPTER; B. D. Horton, Detroit, Mich. App. filed May 20, 1927.

1,680,790. SYSTEM FOR REGULATING THE DIRECT-CURRENT VOLTAGE IN METAL-VAPOR-RECTIFIER INSTALLATIONS; J. Jonas, Meierhof, Baden, Switzerland. App. filed Oct. 8, 1920.

1,680,795. BRUSH-LIFTING DEVICE FOR ELECTRIC MOTORS; G. H. Leland, Dayton, Ohio. App. filed March 18, 1926.

1,680,803. REGULATOR; R. M. Petersime, Gettysburg, Ohio. App. filed Dec. 8, 1925.

1,680,806. REGULATING SYSTEM FOR MAINTAINING ELECTRIC CONVERTERS AT A CONSTANT SPEED; K. Schmidt, Berlin-Sudende, Germany. App. filed Jan. 15, 1924.

1,680,809. HAIR-CURLING APPARATUS; W. G. Shelton, New York, N. Y. App. filed Aug. 7, 1926.

1,680,829. TROLLEY GUARD; G. Weber, Pittsburgh, Pa. App. filed April 20, 1927.

1,680,841. ELECTRIC-CIRCUIT TRACER; H. R. Bartlett, West Hartford, Conn. App. filed Dec. 10, 1926.

1,680,844. WELDING OF COPPER AND COPPER ALLOYS; F. M. Becket, New York, N. Y. App. filed Feb. 21, 1922.

1,680,849. ELECTRIC-METER-TESTING APPARATUS; H. J. Blakeslee, Hartford, Conn. App. filed May 26, 1927.

1,680,910. EARTHING CHOKING COIL OR VOLTAGE TRANSFORMER FOR HIGH VOLTAGES; E. Pfiffner, Frybourg, Switzerland. App. filed June 9, 1925.

1,680,940. SLEEVE TERMINAL BOX FOR ELECTRIC CABLES; W. W. Emmons, Newark, N. J. App. filed Jan. 18, 1923.

1,680,947. STORAGE-BATTERY-CHARGING SYSTEM; W. T. Knieszner, New York, N. Y. App. filed March 19, 1925.

1,680,969. CUT-OUT AND PLUG; W. P. Briggs, New Bedford, Mass. App. filed Aug. 4, 1926.

1,681,004, 1,681,005. POWER-FACTOR CONTROL FOR POWER SYSTEMS; S. Melton, Sturgis, Ky. Apps. filed Nov. 10, 1925 and June 9, 1926.

1,681,081. JOINT; W. Bailey, Washington, D. C. App. filed Nov. 11, 1927.

1,681,097. CAPPED ELBOW; L. H. Church, Roselle, N. J. App. filed Jan. 26, 1924.

1,681,099. PORTABLE MELTING POT; W. F. Clark, Warren, Pa. App. filed April 14, 1924.

1,681,114. RADIATOR COVER AND ELECTRIC HEATER; J. L. Gordon, Brooklyn, N. Y. App. filed Feb. 10, 1928.

1,681,116. TIME-ACTUATED ELECTRIC SWITCH; C. L. Hershey, Leaman Place, Pa. App. filed Dec. 10, 1925.

1,681,129. GROUND FITTING; A. M. Nugent, Unionville, N. Y. App. filed April 20, 1927.

1,681,132. SUPPORTING STAND AND CONTROL SWITCH FOR ELECTRIC IRONS; M. A. Reynolds, Auburn, Maine. App. filed Dec. 22, 1925.

1,681,151. LIGHTING FIXTURE; E. J. Dailey, Jr., New York, N. Y. App. filed Sept. 21, 1925.

(Issued Aug. 21, 1928)

17,068 (reissue). ELECTRIC CONNECTING PLUG; J. G. Peterson, West Hartford, Conn. App. filed Sept. 22, 1926.

1,681,158. AUTOMATIC SWITCHING SYSTEM; A. E. Anderson, Scotia, N. Y. App. filed April 28, 1927.

1,681,186. ELECTRICAL FITTING; J. S. Jones and S. N. Mead, Jr., Brooklyn, N. Y. App. filed June 11, 1923.

1,681,194. SIGN FLASHER; J. G. Ruckelshaus, Newark, N. J. App. filed Oct. 23, 1924.

1,681,196. DEVICE FOR BREAKING THE CONNECTIONS OF ELECTRIC CIRCUITS; R. Rudenberg, Berlin-Grunewald, R. G. Berthold, Berlin-Siemensstadt, and K. Donat, Berlin-Charlottenburg, Germany. App. filed July 2, 1926.

1,681,214. CONSTRUCTION FOR FLATIRONS; R. S. Blair, Stamford, Conn. App. filed Feb. 26, 1923.

1,681,265. ELECTRIC SYSTEM; R. H. Sullivan, Rochester, N. Y. App. filed Sept. 8, 1924.

1,681,268. FLOAT-OPERATED RHEOSTAT; L. R. Titcomb. Brooklyn, N. Y. App. filed Feb. 7, 1925.

1,681,291. SADIRON RECEPTACLE; E. E. Glass, Los Angeles, Calif. App. filed May 25, 1927.

1,681,351. SPEED-CONTROL SYSTEM FOR ELECTRIC ELEVATORS; J. D. Lewis, and G. W. Lautrup, Yonkers, N. Y. App. filed July 13, 1922.

1,681,367. ELECTRICAL TESTING INSTRUMENT; G. B. Rolfe, London, England. App. filed April 11, 1923.

1,681,378. INSULATOR; A. G. Steinmayer, Milwaukee, Wis. App. filed Aug. 29, 1924.

1,681,385. TRANSMISSION OF POWER TO VEHICLES; A. U. Avera, Birmingham, Ala. App. filed July 13, 1922.

1,681,425. ELECTRIC SOCKET; E. Moxter, St. Louis, Mo. App. filed Nov. 22, 1923.

1,681,435. MOTOR CONTROLLER; F. J. Russell, Wauwatosa, Wis. App. filed June 1, 1926.

1,681,459. ELECTRIC MOTOR CONTROL; D. M. Bliss, Syracuse, N. Y. App. filed Nov. 20, 1924.

1,681,471. SAFETY DEVICE FOR SERIES-CONNECTED INCANDESCENT ELECTRIC LAMPS; F. Eckhardt and M. Hohnekamp, Eisenach, Germany. App. filed July 16, 1926.

1,681,473. ELECTROMAGNETIC RELAY; J. Erickson, Chicago, Ill. App. filed Sept. 7, 1920.

1,681,514. PROTECTIVE APPARATUS; F. F. Brand, Pittsfield, Mass. App. filed June 9, 1926.

1,681,519. REGULATING SYSTEM; J. R. Craighead, Schenectady, N. Y. App. filed Aug. 2, 1926.

1,681,523. APPARATUS FOR HEATING OIL WELLS; P. V. Downey and C. H. Wendroff, Denver, Colo. App. filed March 26, 1927.

1,681,541. ELECTRICAL CONDUCTOR; J. Johnston, New Haven, Conn. App. filed May 5, 1924.

1,681,542. REPEATER-MOTOR INDICATOR; R. E. Kortepeter, Brooklyn, and A. Amundsen, Glendale, N. Y. App. filed Dec. 1, 1921.

1,681,558. ELECTRIC SWITCH; J. Schlagenhaufer, Munich, Germany. App. filed Oct. 4, 1923.

1,681,568. ARRANGEMENT FOR GOVERNING SPEED OF ASYNCHRONOUS MOTORS; O. Bohm, Berlin, Germany. App. filed Sept. 24, 1924.

1,681,573. TRANSFORMER; G. W. Elmen, Leonia, N. J. App. filed May 30, 1924.

1,681,594. COVER FOR CONDUIT-OUTLET BOXES; J. T. Pearson and R. H. Olley, Syracuse, N. Y. App. filed April 15, 1925.

1,681,604. ELECTRIC WELDING MECHANISM; J. W. Winter, Penfield, Pa. App. filed June 6, 1924.

1,681,632. MEANS FOR SUPPRESSING HIGH HARMONICS IN COMMUTATING ELECTRIC MACHINES; A. Ytterberg, Vasteras, Sweden. App. filed June 22, 1922.

1,681,678. SOCKET BOX; T. O'Donnell, Ironwood, Mich. App. filed Oct. 15, 1926.

1,681,720. SYNCHRONOUS ELECTRIC VIBRATOR; J. R. Barnhart, Cleveland, Ohio. App. filed Feb. 10, 1923.

1,681,722. CIRCUIT CONTROLLER; A. W. Burke, Pelham Manor, N. Y. App. filed Aug. 13, 1921.

1,681,736. THERAPEUTIC LAMP; A. A. Kull, Milton, Wis. App. filed July 26, 1926.

1,681,766. ELECTRIC-METER GUARD; C. J. Gillen, Carbondale, Pa. App. filed Nov. 9, 1926.

1,681,774. ALTERNATING-CURRENT SWITCH; F. W. Lee, Owings Mills and M. W. Pullen, Towson, Md. App. filed Oct. 24, 1925.

1,681,780. DYNAMO-ELECTRIC MACHINE; N. Pensabene, London, England. App. filed Dec. 27, 1927.

New Trade Literature

POLES.—The MacGillis & Gibbs Company, Milwaukee, Wis., is distributing an illustrated catalog giving complete information on the preparation, preservation and distribution of cedar poles. The catalog also contains data on dimensions, weights and number of cedar poles required for a carload, comparative strengths of Western red cedar and creosoted Southern yellow pine poles, methods of measuring poles, specifications, method of counting and unloading poles, etc.

TRAFFIC BEACONS.—The General Electric Company, Schenectady, N. Y., is distributing bulletin GEA-741A, describing and illustrating the G-E "Novalux" traffic beacons.

TRACTORS. — The Caterpillar Tractor Company, San Leandro, Calif., is distributing four booklets covering different phases of industry. The titles are "Caterpillar Power for Public Utilities," "Caterpillar Power for Factories," "Caterpillar Power for Mines and Quarries" and "Caterpillar Power for Railroads, Warehouses and Docks." They are illustrated with action photographs gathered from "Caterpillar" jobs throughout the world.

STEAM TABLES. — The Superheater Company, 17 East 42d Street, New York City, has published a folder which gives the properties of saturated and superheated steam in convenient form, from 0.0886 to 3,300 lb. absolute pressure. A heat-entropy diagram also is included.

OIL CIRCUIT BREAKERS. Publication L 20360 issued by the Westinghouse Electric & Manufacturing Company describes the type FO-24 outdoor oil circuit breaker for hand or electrical operation.

SWITCHING EQUIPMENT. Pacific Electric Types Y and YS switches are described in Bulletin No. 15 issued by the Pacific Electric Manufacturing Corporation, San Francisco. The bulletin includes a description and specifications of the switches as well as a schedule of ratings and dimensions for the various types.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Valparaiso, Chile (No. 33,153), for illuminated advertising signs.

An agency is desired in Berlin, Germany (No. 33,080), for electric coffee grinders and meat cutters.

An agency is desired in Santos, Brazil (No. 33,031), for electric coffee grinders, meat-slicing machines and refrigerators.

An agency is desired in Shanghai, China (No. 33,079), for electric face and hair drying apparatus.

Purchase and agency are desired in London, England (No. 33,091), for electrical equipment.

Purchase is desired in Winnipeg, Canada (No. 33,078), of carbon heating elements for electrical heaters.

An agency is desired in La Chaux de Fonds, Switzerland (No. 33,041), for household electrical appliances.

An agency is desired in Tientsin, China (No. 33,043), for household electrical appliances.

An agency is desired in Rio de Janeiro, Brazil (No. 33,082), for electric and automatic railway signals.

Purchase is desired in Bucharest, Rumania (No. 33,114), of electrical refrigerators.

D. J. Firts, director of Firts Brothers Pty., Ltd., Melbourne, Australia, arrived in San Francisco and wishes to secure agency connections for all kinds of electrical labor-saving devices, particularly electric refrigerators and washing machines. This firm now acts as distributor for a number of American manufacturers. Mr. Firts will go to Chicago for six weeks, then will proceed to Detroit and New York. Firms interested should furnish catalogs and price lists to the nearest Department of Commerce bureau district office on Mr. Firsts' itinerary.